SEQUENCE LISTING

<110> AKZO Nobel N.V.

<120> *Lawsonia intracellularis* subunit vaccines.

<130> 2004.001

<160> 18

<170> PatentIn version 3.2

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<222> (16)..(2085)

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gga ctt tta agt cat ggc gaa aag atg aat gtt att ggt aat aac ata        99
Gly Leu Leu Ser His Gly Glu Lys Met Asn Val Ile Gly Asn Asn Ile
        15                  20                  25

gct aac gta aat aca gta ggc ttt aaa ggc caa cgt atg gat ttc gca       147
Ala Asn Val Asn Thr Val Gly Phe Lys Gly Gln Arg Met Asp Phe Ala
        30                  35                  40

gac ttt att tat caa gat ggc ttt agt act gca ggg att aca caa att       195
Asp Phe Ile Tyr Gln Asp Gly Phe Ser Thr Ala Gly Ile Thr Gln Ile
45                  50                  55                  60

gga cgt ggt gta ggc att gga gct gtc atg ggg aac ttt ggt cag ggt       243
Gly Arg Gly Val Gly Ile Gly Ala Val Met Gly Asn Phe Gly Gln Gly
                65                  70                  75

agt ttt gaa acc aca act gaa gca aca gac ctt gct att ggt ggt cgt       291
Ser Phe Glu Thr Thr Thr Glu Ala Thr Asp Leu Ala Ile Gly Gly Arg
                80                  85                  90

gga ttt ttc aaa gtt aaa cca caa gga tca gag act tca tat tat acc       339
Gly Phe Phe Lys Val Lys Pro Gln Gly Ser Glu Thr Ser Tyr Tyr Thr
                95                  100                 105

cgt gca ggt aat ttt cgt ttt aat aat gat gga tac tta gtt gat cct       387
Arg Ala Gly Asn Phe Arg Phe Asn Asn Asp Gly Tyr Leu Val Asp Pro
        110                 115                 120

cat gga tat gct ctt cag ggt tgg aaa att gat aat act gaa ggg cca       435
His Gly Tyr Ala Leu Gln Gly Trp Lys Ile Asp Asn Thr Glu Gly Pro
125                 130                 135                 140

caa cgt atc tca ggt ggt gtt aat cca ggt aca aat act tcg cag att       483
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        Gln Arg Ile Ser Gly Gly Val Asn Pro Gly Thr Asn Thr Ser Gln Ile
                    145                 150                 155

        atg ggt aca ggt gaa cca aca gat atc cgt ctt gat act tgg aca gtt    531
        Met Gly Thr Gly Glu Pro Thr Asp Ile Arg Leu Asp Thr Trp Thr Val
                    160                 165                 170

        gca cct tta cag aca aca aat gta agt ttt aac gta aac ctt tct tct    579
        Ala Pro Leu Gln Thr Thr Asn Val Ser Phe Asn Val Asn Leu Ser Ser
                    175                 180                 185

        gat aaa tct gga gat aaa tct caa aac gtt aat agt cca ttt acc tca    627
        Asp Lys Ser Gly Asp Lys Ser Gln Asn Val Asn Ser Pro Phe Thr Ser
                    190                 195                 200

        tta ttt aat ata tgg aat ggt aaa caa cca agt gaa cct aac aat cca    675
        Leu Phe Asn Ile Trp Asn Gly Lys Gln Pro Ser Glu Pro Asn Asn Pro
        205                 210                 215                 220

        cct atg cct gaa agt gca tat agt tat cag aca tct att aag gta tat    723
        Pro Met Pro Glu Ser Ala Tyr Ser Tyr Gln Thr Ser Ile Lys Val Tyr
                    225                 230                 235

        gat gaa gct ggt gga aca cat aca tta aca gtc tat ttt gac caa gtt    771
        Asp Glu Ala Gly Gly Thr His Thr Leu Thr Val Tyr Phe Asp Gln Val
                    240                 245                 250

        tct cct aaa gac tac aaa ggt ggt gga agt gga gaa agt gta tgg gaa    819
        Ser Pro Lys Asp Tyr Lys Gly Gly Gly Ser Gly Glu Ser Val Trp Glu
                    255                 260                 265

        tac gtt gtt act atg gat cct tct gaa gat aat cgc caa gtt tct gtt    867
        Tyr Val Val Thr Met Asp Pro Ser Glu Asp Asn Arg Gln Val Ser Val
                    270                 275                 280

        ggt ggt aac att gtg gac atc aaa gat act aaa gct gca gga atg tta    915
        Gly Gly Asn Ile Val Asp Ile Lys Asp Thr Lys Ala Ala Gly Met Leu
        285                 290                 295                 300

        atg tca gga aca ttg agt ttt gat agc tca gga aaa ctt gca aac caa    963
        Met Ser Gly Thr Leu Ser Phe Asp Ser Ser Gly Lys Leu Ala Asn Gln
                    305                 310                 315

        agt gca tat tcg ctg aat ggt tca cgt aag cct gca gtt gat cct gca    1011
        Ser Ala Tyr Ser Leu Asn Gly Ser Arg Lys Pro Ala Val Asp Pro Ala
                    320                 325                 330

        acc gga gct ctt att aat ggt aat ggt ttt act att gat aga gat gga    1059
        Thr Gly Ala Leu Ile Asn Gly Asn Gly Phe Thr Ile Asp Arg Asp Gly
                    335                 340                 345

        aat gca att cct att ctt aat ata gat aat cca gct gaa aac ttc tat    1107
        Asn Ala Ile Pro Ile Leu Asn Ile Asp Asn Pro Ala Glu Asn Phe Tyr
        350                 355                 360

        cca gca gaa gtt tct aat aat gga ttt cct atg att gta gct aat ttt    1155
        Pro Ala Glu Val Ser Asn Asn Gly Phe Pro Met Ile Val Ala Asn Phe
        365                 370                 375                 380

        act ggt gtc cca ggt aaa aat aca gct gga tct gtt ggt gat gct acc    1203
        Thr Gly Val Pro Gly Lys Asn Thr Ala Gly Ser Val Gly Asp Ala Thr
                    385                 390                 395

        acc ttt ttt aca gaa att gac ttt ggt tta aaa gct act gat ctt gat    1251
        Thr Phe Phe Thr Glu Ile Asp Phe Gly Leu Lys Ala Thr Asp Leu Asp
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                    400                    405                    410

aat aca tgg aag aat gca aat gaa cct ctt tct tct tta agc tat aaa     1299
Asn Thr Trp Lys Asn Ala Asn Glu Pro Leu Ser Ser Leu Ser Tyr Lys
        415                    420                    425

aaa aca cat aat cct atg gat gtc gca ggt ggt tgg aca gtt ggt ggg     1347
Lys Thr His Asn Pro Met Asp Val Ala Gly Gly Trp Thr Val Gly Gly
        430                    435                    440

tat aaa act cca gct cca tca gta act gaa ctt ggt atg gct cag ata     1395
Tyr Lys Thr Pro Ala Pro Ser Val Thr Glu Leu Gly Met Ala Gln Ile
445                    450                    455                    460

ttg gaa aat cct gct ggg gta atg cca caa tat tat ttt ggt aac cct     1443
Leu Glu Asn Pro Ala Gly Val Met Pro Gln Tyr Tyr Phe Gly Asn Pro
                465                    470                    475

aac tat gat aac aca gtt cca cag agt cca cca tat gta tat aaa aat     1491
Asn Tyr Asp Asn Thr Val Pro Gln Ser Pro Pro Tyr Val Tyr Lys Asn
                480                    485                    490

gaa gct tct tat cag gct gca tat aag act gca tta act gcc gca ggt     1539
Glu Ala Ser Tyr Gln Ala Ala Tyr Lys Thr Ala Leu Thr Ala Ala Gly
            495                    500                    505

ggt acc gca gct gac att aaa aag gaa cat tgg cct cat aat gct gca     1587
Gly Thr Ala Ala Asp Ile Lys Lys Glu His Trp Pro His Asn Ala Ala
        510                    515                    520

tca ggt ata tta gaa gct aat gat cca cca aat gtt aaa gac tta gct     1635
Ser Gly Ile Leu Glu Ala Asn Asp Pro Pro Asn Val Lys Asp Leu Ala
525                    530                    535                    540

aat atg aat gga aca cca aac cgc tta tca aat gcg ttt act aac tat     1683
Asn Met Asn Gly Thr Pro Asn Arg Leu Ser Asn Ala Phe Thr Asn Tyr
                545                    550                    555

gca ggt ggt agc tct aca aaa tct gca agt caa aat ggt tat ggt ttt     1731
Ala Gly Gly Ser Ser Thr Lys Ser Ala Ser Gln Asn Gly Tyr Gly Phe
                560                    565                    570

ggt gat tta atg aac tat agt gta aat gct gag gga gtg tta ttt gga     1779
Gly Asp Leu Met Asn Tyr Ser Val Asn Ala Glu Gly Val Leu Phe Gly
            575                    580                    585

gta tat tca aat gga gta caa ctt cca tta tat caa gta gct ctt tat     1827
Val Tyr Ser Asn Gly Val Gln Leu Pro Leu Tyr Gln Val Ala Leu Tyr
        590                    595                    600

gat ttt aac tct aaa cag ggg tta cgt cgt gaa ggt ggt aac tta ttt     1875
Asp Phe Asn Ser Lys Gln Gly Leu Arg Arg Glu Gly Gly Asn Leu Phe
605                    610                    615                    620

agt caa aca aga gaa tca ggg gac cca tct tca ggt gct gca aac act     1923
Ser Gln Thr Arg Glu Ser Gly Asp Pro Ser Ser Gly Ala Ala Asn Thr
                625                    630                    635

tct ggg ttt ggt tca att aac gct aat act tta gaa gga tca aac gta     1971
Ser Gly Phe Gly Ser Ile Asn Ala Asn Thr Leu Glu Gly Ser Asn Val
                640                    645                    650

gat ata tct aca gag ttt gtc tca atg att gca aca caa cgt gga ttc     2019
Asp Ile Ser Thr Glu Phe Val Ser Met Ile Ala Thr Gln Arg Gly Phe
                655                    660                    665
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cag tca aat agt aaa att gta act act att gac caa atg tta gag aca    2067
Gln Ser Asn Ser Lys Ile Val Thr Thr Ile Asp Gln Met Leu Glu Thr
    670             675                 680

gtt gta aat atg aag cgt tag                                        2088
Val Val Asn Met Lys Arg
685                 690
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<210> 2
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His Gly Glu Lys Met Asn Val Ile Gly Asn Asn Ile Ala Asn Val Asn
            20                  25                  30

Thr Val Gly Phe Lys Gly Gln Arg Met Asp Phe Ala Asp Phe Ile Tyr
        35                  40                  45

Gln Asp Gly Phe Ser Thr Ala Gly Ile Thr Gln Ile Gly Arg Gly Val
    50                  55                  60

Gly Ile Gly Ala Val Met Gly Asn Phe Gly Gln Gly Ser Phe Glu Thr
65                  70                  75                  80

Thr Thr Glu Ala Thr Asp Leu Ala Ile Gly Gly Arg Gly Phe Phe Lys
                85                  90                  95

Val Lys Pro Gln Gly Ser Glu Thr Ser Tyr Tyr Thr Arg Ala Gly Asn
            100                 105                 110

Phe Arg Phe Asn Asn Asp Gly Tyr Leu Val Asp Pro His Gly Tyr Ala
        115                 120                 125

Leu Gln Gly Trp Lys Ile Asp Asn Thr Glu Gly Pro Gln Arg Ile Ser
    130                 135                 140

Gly Gly Val Asn Pro Gly Thr Asn Thr Ser Gln Ile Met Gly Thr Gly
145                 150                 155                 160

Glu Pro Thr Asp Ile Arg Leu Asp Thr Trp Thr Val Ala Pro Leu Gln
                165                 170                 175

Thr Thr Asn Val Ser Phe Asn Val Asn Leu Ser Ser Asp Lys Ser Gly
            180                 185                 190
```

```
Asp Lys Ser Gln Asn Val Asn Ser Pro Phe Thr Ser Leu Phe Asn Ile
        195             200             205

Trp Asn Gly Lys Gln Pro Ser Glu Pro Asn Asn Pro Pro Met Pro Glu
        210             215             220

Ser Ala Tyr Ser Tyr Gln Thr Ser Ile Lys Val Tyr Asp Glu Ala Gly
225             230             235             240

Gly Thr His Thr Leu Thr Val Tyr Phe Asp Gln Val Ser Pro Lys Asp
            245             250             255

Tyr Lys Gly Gly Gly Ser Gly Glu Ser Val Trp Glu Tyr Val Val Thr
            260             265             270

Met Asp Pro Ser Glu Asp Asn Arg Gln Val Ser Val Gly Gly Asn Ile
        275             280             285

Val Asp Ile Lys Asp Thr Lys Ala Ala Gly Met Leu Met Ser Gly Thr
        290             295             300

Leu Ser Phe Asp Ser Ser Gly Lys Leu Ala Asn Gln Ser Ala Tyr Ser
305             310             315             320

Leu Asn Gly Ser Arg Lys Pro Ala Val Asp Pro Ala Thr Gly Ala Leu
            325             330             335

Ile Asn Gly Asn Gly Phe Thr Ile Asp Arg Asp Gly Asn Ala Ile Pro
            340             345             350

Ile Leu Asn Ile Asp Asn Pro Ala Glu Asn Phe Tyr Pro Ala Glu Val
        355             360             365

Ser Asn Asn Gly Phe Pro Met Ile Val Ala Asn Phe Thr Gly Val Pro
370             375             380

Gly Lys Asn Thr Ala Gly Ser Val Gly Asp Ala Thr Thr Phe Phe Thr
385             390             395             400

Glu Ile Asp Phe Gly Leu Lys Ala Thr Asp Leu Asp Asn Thr Trp Lys
            405             410             415

Asn Ala Asn Glu Pro Leu Ser Ser Leu Ser Tyr Lys Lys Thr His Asn
        420             425             430

Pro Met Asp Val Ala Gly Gly Trp Thr Val Gly Gly Tyr Lys Thr Pro
        435             440             445

Ala Pro Ser Val Thr Glu Leu Gly Met Ala Gln Ile Leu Glu Asn Pro
```

```
              450                  455                  460
Ala Gly Val Met Pro Gln Tyr Tyr Phe Gly Asn Pro Asn Tyr Asp Asn
465                 470                 475                 480

Thr Val Pro Gln Ser Pro Pro Tyr Val Tyr Lys Asn Glu Ala Ser Tyr
                485                 490                 495

Gln Ala Ala Tyr Lys Thr Ala Leu Thr Ala Ala Gly Gly Thr Ala Ala
            500                 505                 510

Asp Ile Lys Lys Glu His Trp Pro His Asn Ala Ala Ser Gly Ile Leu
            515                 520                 525

Glu Ala Asn Asp Pro Pro Asn Val Lys Asp Leu Ala Asn Met Asn Gly
        530                 535                 540

Thr Pro Asn Arg Leu Ser Asn Ala Phe Thr Asn Tyr Ala Gly Gly Ser
545                 550                 555                 560

Ser Thr Lys Ser Ala Ser Gln Asn Gly Tyr Gly Phe Gly Asp Leu Met
                565                 570                 575

Asn Tyr Ser Val Asn Ala Glu Gly Val Leu Phe Gly Val Tyr Ser Asn
                580                 585                 590

Gly Val Gln Leu Pro Leu Tyr Gln Val Ala Leu Tyr Asp Phe Asn Ser
            595                 600                 605

Lys Gln Gly Leu Arg Arg Glu Gly Gly Asn Leu Phe Ser Gln Thr Arg
        610                 615                 620

Glu Ser Gly Asp Pro Ser Ser Gly Ala Ala Asn Thr Ser Gly Phe Gly
625                 630                 635                 640

Ser Ile Asn Ala Asn Thr Leu Glu Gly Ser Asn Val Asp Ile Ser Thr
                645                 650                 655

Glu Phe Val Ser Met Ile Ala Thr Gln Arg Gly Phe Gln Ser Asn Ser
                660                 665                 670

Lys Ile Val Thr Thr Ile Asp Gln Met Leu Glu Thr Val Val Asn Met
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Lys Arg
    690
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                                   Met Phe Arg Met Ile Val Phe
                                   1           5


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Phe Thr Val Gly Ile Ile Met Leu Ile Leu Ala Cys Leu Ala Ala Leu
        10              15              20


gag ttc ata caa gat ttt ccc aat agc tat caa gaa gat gga caa atg      148
Glu Phe Ile Gln Asp Phe Pro Asn Ser Tyr Gln Glu Asp Gly Gln Met
    25              30              35


gtt aca gga att att tca aaa ata ata ggc tct aac tgt gat aat tct      196
Val Thr Gly Ile Ile Ser Lys Ile Ile Gly Ser Asn Cys Asp Asn Ser
40              45              50              55


tca aca tct gat ata aat aat aag aaa tcc ata gat aga gat aaa gat      244
Ser Thr Ser Asp Ile Asn Asn Lys Lys Ser Ile Asp Arg Asp Lys Asp
                60              65              70


aca tta ctc tca agt agt aat aga aat aca ata caa gcc ggt act cca      292
Thr Leu Leu Ser Ser Ser Asn Arg Asn Thr Ile Gln Ala Gly Thr Pro
            75              80              85


cat caa gaa aat aac ata aaa gaa gat ctt caa ctg act aac aaa aat      340
His Gln Glu Asn Asn Ile Lys Glu Asp Leu Gln Leu Thr Asn Lys Asn
        90              95              100


gaa caa aca act cca gaa gaa gaa gaa gaa agt aaa ttt att tgg tta      388
Glu Gln Thr Thr Pro Glu Glu Glu Glu Glu Ser Lys Phe Ile Trp Leu
    105             110             115


aca gaa gct cca tca gag ctt aaa aaa gga gaa aaa gct ata aca caa      436
Thr Glu Ala Pro Ser Glu Leu Lys Lys Gly Glu Lys Ala Ile Thr Gln
120             125             130             135


aca aga ttg tct att ggt aag gat ata tct ttt aga att act gct gat      484
Thr Arg Leu Ser Ile Gly Lys Asp Ile Ser Phe Arg Ile Thr Ala Asp
                140             145             150


gat gcc atc aaa gct caa tca atg atg tta aaa aat cca gat agg ttt      532
Asp Ala Ile Lys Ala Gln Ser Met Met Leu Lys Asn Pro Asp Arg Phe
            155             160             165


gtt tta gat ctt caa gga aag tgg ggt att tcc ctt cca cct att cca      580
Val Leu Asp Leu Gln Gly Lys Trp Gly Ile Ser Leu Pro Pro Ile Pro
        170             175             180


cct aca aat cct tgg tta aaa aaa ata cgc tta ggt act aat aat gga      628
Pro Thr Asn Pro Trp Leu Lys Lys Ile Arg Leu Gly Thr Asn Asn Gly
        185             190             195


aat aca cga ctt gtc ttt gat ctt caa aaa aaa cca tct aaa act gaa      676
Asn Thr Arg Leu Val Phe Asp Leu Gln Lys Lys Pro Ser Lys Thr Glu
200             205             210             215
```

```
att aaa caa tta gat aca aat aaa att gaa atc caa att cattaaattg       725
Ile Lys Gln Leu Asp Thr Asn Lys Ile Glu Ile Gln Ile
            220              225

catattagac aataagttat aataaa                                         751
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1               5                   10                  15

Leu Ala Cys Leu Ala Ala Leu Glu Phe Ile Gln Asp Phe Pro Asn Ser
            20                  25                  30

Tyr Gln Glu Asp Gly Gln Met Val Thr Gly Ile Ile Ser Lys Ile Ile
            35                  40                  45

Gly Ser Asn Cys Asp Asn Ser Ser Thr Ser Asp Ile Asn Asn Lys Lys
    50                  55                  60

Ser Ile Asp Arg Asp Lys Asp Thr Leu Leu Ser Ser Ser Asn Arg Asn
65                  70                  75                  80

Thr Ile Gln Ala Gly Thr Pro His Gln Glu Asn Asn Ile Lys Glu Asp
                85                  90                  95

Leu Gln Leu Thr Asn Lys Asn Glu Gln Thr Thr Pro Glu Glu Glu Glu
            100                 105                 110

Glu Ser Lys Phe Ile Trp Leu Thr Glu Ala Pro Ser Glu Leu Lys Lys
            115                 120                 125

Gly Glu Lys Ala Ile Thr Gln Thr Arg Leu Ser Ile Gly Lys Asp Ile
    130                 135                 140

Ser Phe Arg Ile Thr Ala Asp Asp Ala Ile Lys Ala Gln Ser Met Met
145                 150                 155                 160

Leu Lys Asn Pro Asp Arg Phe Val Leu Asp Leu Gln Gly Lys Trp Gly
                165                 170                 175

Ile Ser Leu Pro Pro Ile Pro Pro Thr Asn Pro Trp Leu Lys Lys Ile
                180                 185                 190

Arg Leu Gly Thr Asn Asn Gly Asn Thr Arg Leu Val Phe Asp Leu Gln
            195                 200                 205
```

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Lys Lys Pro Ser Lys Thr Glu Ile Lys Gln Leu Asp Thr Asn Lys Ile
    210              215             220
```

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Glu Ile Gln Ile
225
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<222>   (34)..(1677)
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                                     Met His Gln Lys Ser Cys Leu
                                      1               5
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```
gtt gct tta tgt att atg ttt att att atg gtg caa gtt ctt cag gca        102
Val Ala Leu Cys Ile Met Phe Ile Ile Met Val Gln Val Leu Gln Ala
        10              15                  20
```

```
aat gca gct agc tat gtg gtt ttg cca ttt aaa gta aat gct cct cca        150
Asn Ala Ala Ser Tyr Val Val Leu Pro Phe Lys Val Asn Ala Pro Pro
    25              30                  35
```

```
agc tat act tat ttg gaa aaa gct atc cca tct atg tta act tct aga        198
Ser Tyr Thr Tyr Leu Glu Lys Ala Ile Pro Ser Met Leu Thr Ser Arg
40              45                  50                  55
```

```
ctt tat tgg gaa gaa cgt ttt caa cct atc ccg gat gct aat gct att        246
Leu Tyr Trp Glu Glu Arg Phe Gln Pro Ile Pro Asp Ala Asn Ala Ile
                60                  65                  70
```

```
aaa gca gga aag gta gaa gat ata aag gaa atg gat aag gca agg ata        294
Lys Ala Gly Lys Val Glu Asp Ile Lys Glu Met Asp Lys Ala Arg Ile
            75                  80                  85
```

```
gct aca ggt gca gac tat ctt ata tgg gga cag gta aat att gta ggt        342
Ala Thr Gly Ala Asp Tyr Leu Ile Trp Gly Gln Val Asn Ile Val Gly
        90                  95                  100
```

```
gat gaa gct acg ctt gat gta caa gtt tgt gat ata gaa gga tca att        390
Asp Glu Ala Thr Leu Asp Val Gln Val Cys Asp Ile Glu Gly Ser Ile
    105                 110                 115
```

```
tgg agg aaa agt aaa aat aca aaa gtt gat aat tta att act gcc ctt        438
Trp Arg Lys Ser Lys Asn Thr Lys Val Asp Asn Leu Ile Thr Ala Leu
120                 125                 130                 135
```

```
caa gat aca gca gat gca att aat agt gag ttg ttt ggg cgt gca act        486
Gln Asp Thr Ala Asp Ala Ile Asn Ser Glu Leu Phe Gly Arg Ala Thr
                140                 145                 150
```

```
aca aaa cca tca tca aaa gct act att gta gct caa atg aac tct gga        534
Thr Lys Pro Ser Ser Lys Ala Thr Ile Val Ala Gln Met Asn Ser Gly
            155                 160                 165
```

```
ttg att aag gga aaa gga aat gaa aat cag tca tat ctt aat cca gaa        582
```

```
Leu Ile Lys Gly Lys Gly Asn Glu Asn Gln Ser Tyr Leu Asn Pro Glu
        170             175                 180


ttt cgt tat caa gga agc aat ctt tcc cgt ggc cga agt caa gct ctt      630
Phe Arg Tyr Gln Gly Ser Asn Leu Ser Arg Gly Arg Ser Gln Ala Leu
    185             190             195


ccc ttt gct tca gtt ggt ata gtt gtt ggt gac ttt ata gga gat aat      678
Pro Phe Ala Ser Val Gly Ile Val Val Gly Asp Phe Ile Gly Asp Asn
200             205             210             215


aaa aat gaa gtt gcc ata tta agt gag tat aaa gtc cat att tat cga      726
Lys Asn Glu Val Ala Ile Leu Ser Glu Tyr Lys Val His Ile Tyr Arg
                220             225             230


tgg gaa gaa gaa agg tta gct ctt ctt gga gaa tat aaa ttc cct cgc      774
Trp Glu Glu Glu Arg Leu Ala Leu Leu Gly Glu Tyr Lys Phe Pro Arg
                235             240             245


tca cta cag tct tta cat att cgt gct ttt gat gtg gat cat gat ggt      822
Ser Leu Gln Ser Leu His Ile Arg Ala Phe Asp Val Asp His Asp Gly
            250             255             260


gta cag gaa atc att gtt tct tgc ttt gat cct tca tat gca aag cca      870
Val Gln Glu Ile Ile Val Ser Cys Phe Asp Pro Ser Tyr Ala Lys Pro
    265             270             275


tat tcg ttt att ctt agt ttt aaa aat aga gtg ttt aaa gag tta gcc      918
Tyr Ser Phe Ile Leu Ser Phe Lys Asn Arg Val Phe Lys Glu Leu Ala
280             285             290             295


aca aac tta cca ttt tat tta aat gtg gtt aaa ctt cca cca gat ttt      966
Thr Asn Leu Pro Phe Tyr Leu Asn Val Val Lys Leu Pro Pro Asp Phe
                300             305             310


tct cct atg tta att ggt caa aag agt gac aat tca agg att ttt tct     1014
Ser Pro Met Leu Ile Gly Gln Lys Ser Asp Asn Ser Arg Ile Phe Ser
            315             320             325


ccc tct ggg gtt tat gaa ata gaa aaa cat gga cgt aac tat ata atg     1062
Pro Ser Gly Val Tyr Glu Ile Glu Lys His Gly Arg Asn Tyr Ile Met
            330             335             340


gga aat cgt ctt agt ctt cca aag gaa gct aat att ttt aat ttt tct     1110
Gly Asn Arg Leu Ser Leu Pro Lys Glu Ala Asn Ile Phe Asn Phe Ser
    345             350             355


tgg tta cca tca gat tca tta aaa gat gaa gaa gct aag tta gta ctt     1158
Trp Leu Pro Ser Asp Ser Leu Lys Asp Glu Glu Ala Lys Leu Val Leu
360             365             370             375


gta acc aat aat gaa aga tta gtt gta tat aat aca aaa ggt aca aga     1206
Val Thr Asn Asn Glu Arg Leu Val Val Tyr Asn Thr Lys Gly Thr Arg
                380             385             390


ctt ttt atg act gaa gaa gtg tat tat ggt tct tct gtt ggt ata gac     1254
Leu Phe Met Thr Glu Glu Val Tyr Tyr Gly Ser Ser Val Gly Ile Asp
            395             400             405


gag ccc agt aat atg cct ggt ctt gga aag tca aaa gag ctt atc cct     1302
Glu Pro Ser Asn Met Pro Gly Leu Gly Lys Ser Lys Glu Leu Ile Pro
    410             415             420


tct aaa tat ttt atc cca gga cgg atg att cct att aat ctt gat tca     1350
Ser Lys Tyr Phe Ile Pro Gly Arg Met Ile Pro Ile Asn Leu Asp Ser
```

```
                425                      430                      435

        atg ggg aaa tgg gag ttg ctt gta agc aag cca att tct gtt gca gca    1398
        Met Gly Lys Trp Glu Leu Leu Val Ser Lys Pro Ile Ser Val Ala Ala
        440                 445                 450                 455

        aaa ttt ttt gaa aat tat aga tct ttt gct gaa ggc gaa att cag gct    1446
        Lys Phe Phe Glu Asn Tyr Arg Ser Phe Ala Glu Gly Glu Ile Gln Ala
                            460                 465                 470

        tta aca tgg gac ggc tta gga tta ggt ctt gta tgg aat aca cgt cgt    1494
        Leu Thr Trp Asp Gly Leu Gly Leu Gly Leu Val Trp Asn Thr Arg Arg
                        475                 480                 485

        att aag gga act att aca gat ttt gcc tta gct gat atg aat aat gat    1542
        Ile Lys Gly Thr Ile Thr Asp Phe Ala Leu Ala Asp Met Asn Asn Asp
                    490                 495                 500

        ggg aag tta gac tta gtt gtt tcc gtt aat agc cat aca ggg att ctt    1590
        Gly Lys Leu Asp Leu Val Val Ser Val Asn Ser His Thr Gly Ile Leu
                505                 510                 515

        gga cta gaa aaa cga aag aca att ata gta ttt tat cct tta gag gta    1638
        Gly Leu Glu Lys Arg Lys Thr Ile Ile Val Phe Tyr Pro Leu Glu Val
        520                 525                 530                 535

        gat aaa caa ggt atc cct aag gct gtt gaa gat aac taa ttttttccta    1687
        Asp Lys Gln Gly Ile Pro Lys Ala Val Glu Asp Asn
                            540                 545

        ttaattattt ttttattctg atagttaa                                     1715


        <210>  6
        <211>  547
        <212>  PRT
        <213>  Lawsonia intracellularis

        <400>  6

        Met His Gln Lys Ser Cys Leu Val Ala Leu Cys Ile Met Phe Ile Ile
        1               5                   10                  15

        Met Val Gln Val Leu Gln Ala Asn Ala Ala Ser Tyr Val Val Leu Pro
                        20                  25                  30

        Phe Lys Val Asn Ala Pro Pro Ser Tyr Thr Tyr Leu Glu Lys Ala Ile
                    35                  40                  45

        Pro Ser Met Leu Thr Ser Arg Leu Tyr Trp Glu Glu Arg Phe Gln Pro
                50                  55                  60

        Ile Pro Asp Ala Asn Ala Ile Lys Ala Gly Lys Val Glu Asp Ile Lys
        65                  70                  75                  80

        Glu Met Asp Lys Ala Arg Ile Ala Thr Gly Ala Asp Tyr Leu Ile Trp
                        85                  90                  95

        Gly Gln Val Asn Ile Val Gly Asp Glu Ala Thr Leu Asp Val Gln Val
```

             100   105   110

Cys Asp Ile Glu Gly Ser Ile Trp Arg Lys Ser Lys Asn Thr Lys Val
       115   120   125

Asp Asn Leu Ile Thr Ala Leu Gln Asp Thr Ala Asp Ala Ile Asn Ser
       130   135   140

Glu Leu Phe Gly Arg Ala Thr Thr Lys Pro Ser Ser Lys Ala Thr Ile
145   150   155   160

Val Ala Gln Met Asn Ser Gly Leu Ile Lys Gly Lys Gly Asn Glu Asn
          165   170   175

Gln Ser Tyr Leu Asn Pro Glu Phe Arg Tyr Gln Gly Ser Asn Leu Ser
       180   185   190

Arg Gly Arg Ser Gln Ala Leu Pro Phe Ala Ser Val Gly Ile Val Val
       195   200   205

Gly Asp Phe Ile Gly Asp Asn Lys Asn Glu Val Ala Ile Leu Ser Glu
       210   215   220

Tyr Lys Val His Ile Tyr Arg Trp Glu Glu Glu Arg Leu Ala Leu Leu
225   230   235   240

Gly Glu Tyr Lys Phe Pro Arg Ser Leu Gln Ser Leu His Ile Arg Ala
          245   250   255

Phe Asp Val Asp His Asp Gly Val Gln Glu Ile Ile Val Ser Cys Phe
          260   265   270

Asp Pro Ser Tyr Ala Lys Pro Tyr Ser Phe Ile Leu Ser Phe Lys Asn
       275   280   285

Arg Val Phe Lys Glu Leu Ala Thr Asn Leu Pro Phe Tyr Leu Asn Val
       290   295   300

Val Lys Leu Pro Pro Asp Phe Ser Pro Met Leu Ile Gly Gln Lys Ser
305   310   315   320

Asp Asn Ser Arg Ile Phe Ser Pro Ser Gly Val Tyr Glu Ile Glu Lys
          325   330   335

His Gly Arg Asn Tyr Ile Met Gly Asn Arg Leu Ser Leu Pro Lys Glu
          340   345   350

Ala Asn Ile Phe Asn Phe Ser Trp Leu Pro Ser Asp Ser Leu Lys Asp
       355   360   365

```
Glu Glu Ala Lys Leu Val Leu Val Thr Asn Asn Glu Arg Leu Val Val
    370                 375                 380

Tyr Asn Thr Lys Gly Thr Arg Leu Phe Met Thr Glu Glu Val Tyr Tyr
385                 390                 395                 400

Gly Ser Ser Val Gly Ile Asp Glu Pro Ser Asn Met Pro Gly Leu Gly
                405                 410                 415

Lys Ser Lys Glu Leu Ile Pro Ser Lys Tyr Phe Ile Pro Gly Arg Met
            420                 425                 430

Ile Pro Ile Asn Leu Asp Ser Met Gly Lys Trp Glu Leu Leu Val Ser
            435                 440                 445

Lys Pro Ile Ser Val Ala Ala Lys Phe Phe Glu Asn Tyr Arg Ser Phe
    450                 455                 460

Ala Glu Gly Glu Ile Gln Ala Leu Thr Trp Asp Gly Leu Gly Leu Gly
465                 470                 475                 480

Leu Val Trp Asn Thr Arg Arg Ile Lys Gly Thr Ile Thr Asp Phe Ala
                485                 490                 495

Leu Ala Asp Met Asn Asn Asp Gly Lys Leu Asp Leu Val Val Ser Val
            500                 505                 510

Asn Ser His Thr Gly Ile Leu Gly Leu Glu Lys Arg Lys Thr Ile Ile
            515                 520                 525

Val Phe Tyr Pro Leu Glu Val Asp Lys Gln Gly Ile Pro Lys Ala Val
    530                 535                 540

Glu Asp Asn
545


<210>  7
<211>  1564
<212>  DNA
<213>  Lawsonia intracellularis


<220>
<221>  CDS
<222>  (41)..(1522)

<400>  7
agaagtatgt tctataagta gagtaaggaa tataaaaaat atg gtt agt tat att      55
                                            Met Val Ser Tyr Ile
                                            1               5
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cgt tta tta gga agt ata ttt tta gta tta gca    att ttt ggt tgt ggc      103
Arg Leu Leu Gly Ser Ile Phe Leu Val Leu Ala    Ile Phe Gly Cys Gly
            10              15                          20

gct cag ttt aat aaa ccc tct tta ctt gat gaa    acc cct ata gat tac      151
Ala Gln Phe Asn Lys Pro Ser Leu Leu Asp Glu    Thr Pro Ile Asp Tyr
            25              30                          35

agt tct gta ctt tct gat tac ata gta gaa tta    gaa aaa gaa cca ctt      199
Ser Ser Val Leu Ser Asp Tyr Ile Val Glu Leu    Glu Lys Glu Pro Leu
            40              45                          50

cag tat ata tta cta aaa aaa gaa aaa ttt tct    caa atg gag ata tat      247
Gln Tyr Ile Leu Leu Lys Lys Glu Lys Phe Ser    Gln Met Glu Ile Tyr
            55              60                          65

aat tat caa ttc aca tca caa cat tgg tct cca    gat aat ttt gta tca      295
Asn Tyr Gln Phe Thr Ser Gln His Trp Ser Pro    Asp Asn Phe Val Ser
70              75              80                          85

cct gct ata tgg gaa cat cag gta gat ata tat    atc cct cac cat cca      343
Pro Ala Ile Trp Glu His Gln Val Asp Ile Tyr    Ile Pro His His Pro
                90              95                         100

gtt tca gaa cgt gca ctt ctt atc atc aat aat    ggt att aat aat ggt      391
Val Ser Glu Arg Ala Leu Leu Ile Ile Asn Asn    Gly Ile Asn Asn Gly
                105             110                        115

aca ttt ttt act tct cct aaa gct cca act gat    ttt act cca gaa gta      439
Thr Phe Phe Thr Ser Pro Lys Ala Pro Thr Asp    Phe Thr Pro Glu Val
        120             125                        130

tta gaa gaa atc gct cgt tca aca aaa act gta    gtc att gct cta agt      487
Leu Glu Glu Ile Ala Arg Ser Thr Lys Thr Val    Val Ile Ala Leu Ser
        135             140                        145

gat atc cca aat cag tat ctt act tat aga ggt    gac tgg aga ttt ctt      535
Asp Ile Pro Asn Gln Tyr Leu Thr Tyr Arg Gly    Asp Trp Arg Phe Leu
150             155             160                        165

aag gaa gat gaa agt att gct atg agt tgg tct    agt ttt tta caa gat      583
Lys Glu Asp Glu Ser Ile Ala Met Ser Trp Ser    Ser Phe Leu Gln Asp
                170             175                        180

cca gaa agt cgg tac aca aga cct ctc tat gtc    cct atg gtt gca gca      631
Pro Glu Ser Arg Tyr Thr Arg Pro Leu Tyr Val    Pro Met Val Ala Ala
                185             190                        195

gtt tct cag gca atg act ctt gca gaa aag gag    tta caa gca tta aaa      679
Val Ser Gln Ala Met Thr Leu Ala Glu Lys Glu    Leu Gln Ala Leu Lys
            200             205                        210

att aag cat ttt att gta tct ggt gtg tca aag    cgt gga tgg aca aca      727
Ile Lys His Phe Ile Val Ser Gly Val Ser Lys    Arg Gly Trp Thr Thr
            215             220                        225

tgg ctt tca gct att gct gac tca cga gta gat    gct att acc ccg ttt      775
Trp Leu Ser Ala Ile Ala Asp Ser Arg Val Asp    Ala Ile Thr Pro Phe
230             235             240                        245

gtt att gat gca ttg aat act cgg aaa gtc ctt    gga cat atg tat aaa      823
Val Ile Asp Ala Leu Asn Thr Arg Lys Val Leu    Gly His Met Tyr Lys
                250             255                        260

aca tat gga aat aat tgg cct ata gca ttt tat    cca tat tat aga ttt      871
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```
Thr Tyr Gly Asn Asn Trp Pro Ile Ala Phe Tyr Pro Tyr Tyr Arg Phe
        265             270             275

gat tta gat aaa caa cta gat aca gtt cct ttt ttc aat ctt atg aat    919
Asp Leu Asp Lys Gln Leu Asp Thr Val Pro Phe Phe Asn Leu Met Asn
        280             285             290

att gtt gat cca tat aga tat tta gga aca cca tat aag tct cga ctt    967
Ile Val Asp Pro Tyr Arg Tyr Leu Gly Thr Pro Tyr Lys Ser Arg Leu
        295             300             305

gct atc cct aaa tat att gta aat gca agt gga gat gat ttt tat gtc   1015
Ala Ile Pro Lys Tyr Ile Val Asn Ala Ser Gly Asp Asp Phe Tyr Val
310             315             320             325

cct gat aat tca agt ttt tac tat gat gat ctc cct gga gag aaa gca   1063
Pro Asp Asn Ser Ser Phe Tyr Tyr Asp Asp Leu Pro Gly Glu Lys Ala
            330             335             340

tta cgt ttt gca cca aac tca aat cat cat ggg ata tta aat ttc aca   1111
Leu Arg Phe Ala Pro Asn Ser Asn His His Gly Ile Leu Asn Phe Thr
            345             350             355

aaa caa tcg ctt att cct ttt gtg aat aga gta caa aaa ggt att tca   1159
Lys Gln Ser Leu Ile Pro Phe Val Asn Arg Val Gln Lys Gly Ile Ser
            360             365             370

acg cca gtt tta gat att tcc aca gag atg acg gaa cga gtt caa tat   1207
Thr Pro Val Leu Asp Ile Ser Thr Glu Met Thr Glu Arg Val Gln Tyr
        375             380             385

gtg act gtt cgt ttt tct gaa gtt cca gag aag ata gta ctt tgg aaa   1255
Val Thr Val Arg Phe Ser Glu Val Pro Glu Lys Ile Val Leu Trp Lys
390             395             400             405

gca gca aat cca gag tca cga gat ttt cgt tat gcc tgt cgt gtt agg   1303
Ala Ala Asn Pro Glu Ser Arg Asp Phe Arg Tyr Ala Cys Arg Val Arg
            410             415             420

tac atg gaa aca cca tta cac ctt tct gca aca ggg gaa gtt agc gtt   1351
Tyr Met Glu Thr Pro Leu His Leu Ser Ala Thr Gly Glu Val Ser Val
            425             430             435

tca tta gag atc cct tct gta gga tgg caa gct gct ttt att gaa gct   1399
Ser Leu Glu Ile Pro Ser Val Gly Trp Gln Ala Ala Phe Ile Glu Ala
            440             445             450

aca ttt aaa gat ggt ttt gtt gca aca aca cca gtg tat att tta cca   1447
Thr Phe Lys Asp Gly Phe Val Ala Thr Thr Pro Val Tyr Ile Leu Pro
455             460             465

aaa gat ata tat cca cct ata aaa ata cca cct gta cat gga tta tta   1495
Lys Asp Ile Tyr Pro Pro Ile Lys Ile Pro Pro Val His Gly Leu Leu
470             475             480             485

tgt aag ttt gta cat ggt cga acc tag taactagtag ttgttgtact         1542
Cys Lys Phe Val His Gly Arg Thr
            490

gataatctaa aaggatatag at                                          1564
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<210> 8
<211> 493
<212> PRT

<213> Lawsonia intracellularis

<400> 8

Met Val Ser Tyr Ile Arg Leu Leu Gly Ser Ile Phe Leu Val Leu Ala
1   5   10   15

Ile Phe Gly Cys Gly Ala Gln Phe Asn Lys Pro Ser Leu Leu Asp Glu
            20   25   30

Thr Pro Ile Asp Tyr Ser Ser Val Leu Ser Asp Tyr Ile Val Glu Leu
        35   40   45

Glu Lys Glu Pro Leu Gln Tyr Ile Leu Leu Lys Lys Glu Lys Phe Ser
    50   55   60

Gln Met Glu Ile Tyr Asn Tyr Gln Phe Thr Ser Gln His Trp Ser Pro
65   70   75   80

Asp Asn Phe Val Ser Pro Ala Ile Trp Glu His Gln Val Asp Ile Tyr
                85   90   95

Ile Pro His His Pro Val Ser Glu Arg Ala Leu Leu Ile Ile Asn Asn
            100   105   110

Gly Ile Asn Asn Gly Thr Phe Phe Thr Ser Pro Lys Ala Pro Thr Asp
        115   120   125

Phe Thr Pro Glu Val Leu Glu Glu Ile Ala Arg Ser Thr Lys Thr Val
    130   135   140

Val Ile Ala Leu Ser Asp Ile Pro Asn Gln Tyr Leu Thr Tyr Arg Gly
145   150   155   160

Asp Trp Arg Phe Leu Lys Glu Asp Glu Ser Ile Ala Met Ser Trp Ser
                165   170   175

Ser Phe Leu Gln Asp Pro Glu Ser Arg Tyr Thr Arg Pro Leu Tyr Val
            180   185   190

Pro Met Val Ala Ala Val Ser Gln Ala Met Thr Leu Ala Glu Lys Glu
        195   200   205

Leu Gln Ala Leu Lys Ile Lys His Phe Ile Val Ser Gly Val Ser Lys
    210   215   220

Arg Gly Trp Thr Thr Trp Leu Ser Ala Ile Ala Asp Ser Arg Val Asp
225   230   235   240

Ala Ile Thr Pro Phe Val Ile Asp Ala Leu Asn Thr Arg Lys Val Leu

```
                      245                  250                  255

        Gly His Met Tyr Lys Thr Tyr Gly Asn Asn Trp Pro Ile Ala Phe Tyr
                260              265              270


        Pro Tyr Tyr Arg Phe Asp Leu Asp Lys Gln Leu Asp Thr Val Pro Phe
                275              280              285


        Phe Asn Leu Met Asn Ile Val Asp Pro Tyr Arg Tyr Leu Gly Thr Pro
                290              295              300


        Tyr Lys Ser Arg Leu Ala Ile Pro Lys Tyr Ile Val Asn Ala Ser Gly
        305              310              315              320


        Asp Asp Phe Tyr Val Pro Asp Asn Ser Ser Phe Tyr Tyr Asp Asp Leu
                        325              330              335


        Pro Gly Glu Lys Ala Leu Arg Phe Ala Pro Asn Ser Asn His His Gly
                    340              345              350


        Ile Leu Asn Phe Thr Lys Gln Ser Leu Ile Pro Phe Val Asn Arg Val
                    355              360              365


        Gln Lys Gly Ile Ser Thr Pro Val Leu Asp Ile Ser Thr Glu Met Thr
                370              375              380


        Glu Arg Val Gln Tyr Val Thr Val Arg Phe Ser Glu Val Pro Glu Lys
        385              390              395              400


        Ile Val Leu Trp Lys Ala Ala Asn Pro Glu Ser Arg Asp Phe Arg Tyr
                    405              410              415


        Ala Cys Arg Val Arg Tyr Met Glu Thr Pro Leu His Leu Ser Ala Thr
                    420              425              430


        Gly Glu Val Ser Val Ser Leu Glu Ile Pro Ser Val Gly Trp Gln Ala
                    435              440              445


        Ala Phe Ile Glu Ala Thr Phe Lys Asp Gly Phe Val Ala Thr Thr Pro
                450              455              460


        Val Tyr Ile Leu Pro Lys Asp Ile Tyr Pro Pro Ile Lys Ile Pro Pro
        465              470              475              480


        Val His Gly Leu Leu Cys Lys Phe Val His Gly Arg Thr
                        485              490
```

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<210>  9
<211>  2096
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<212>  DNA
<213>  Lawsonia intracellularis


<220>
<221>  CDS
<222>  (12)..(2096)

<400>  9
aggacaaaac t atg gcg gat tat ctt tca gga gga att tct ttt gga gga        50
           Met Ala Asp Tyr Leu Ser Gly Gly Ile Ser Phe Gly Gly
            1               5                  10

att ggt agt gga acc gat ttc caa gct atg att gat caa ctt aag aaa        98
Ile Gly Ser Gly Thr Asp Phe Gln Ala Met Ile Asp Gln Leu Lys Lys
 15                  20                  25

att gag ctt att cct aaa aat aga ctt gta gtt tcc cat gaa caa tgg       146
Ile Glu Leu Ile Pro Lys Asn Arg Leu Val Val Ser His Glu Gln Trp
 30                  35                  40                  45

aca aaa aaa tat aaa gca ttt gaa gag ctt ata aaa aca gtt aaa gat       194
Thr Lys Lys Tyr Lys Ala Phe Glu Glu Leu Ile Lys Thr Val Lys Asp
                 50                  55                  60

act gaa gcg tct tta agt aag cta agt tct gtt ggt gct att tta aaa       242
Thr Glu Ala Ser Leu Ser Lys Leu Ser Ser Val Gly Ala Ile Leu Lys
             65                  70                  75

aaa gaa ggt tct gtt tca aat act tct gtt gca agc gtt aag gca agt       290
Lys Glu Gly Ser Val Ser Asn Thr Ser Val Ala Ser Val Lys Ala Ser
                 80                  85                  90

tct gat gca tct gat gga aca cat aca att gat gtg aaa cag ctt gca       338
Ser Asp Ala Ser Asp Gly Thr His Thr Ile Asp Val Lys Gln Leu Ala
             95                 100                 105

aca aac acg att ctt tct aat aat cat att ttt gat tct aaa act gaa       386
Thr Asn Thr Ile Leu Ser Asn Asn His Ile Phe Asp Ser Lys Thr Glu
110                 115                 120                 125

agt att aat aat aca ggt tca cct ggt atc ttt gct tat gag tat aaa       434
Ser Ile Asn Asn Thr Gly Ser Pro Gly Ile Phe Ala Tyr Glu Tyr Lys
                130                 135                 140

ggg gaa cta cat gaa gtt gaa gtt cct cca ggt agt gat ctt gaa tat       482
Gly Glu Leu His Glu Val Glu Val Pro Pro Gly Ser Asp Leu Glu Tyr
                145                 150                 155

ctt gca aca tta ata aac aaa gat tct aat aat cct ggt gtt aaa gca       530
Leu Ala Thr Leu Ile Asn Lys Asp Ser Asn Asn Pro Gly Val Lys Ala
             160                 165                 170

aac ctt atc aag act ggc gat ggc tat atg ttt agt ctt gaa gga act       578
Asn Leu Ile Lys Thr Gly Asp Gly Tyr Met Phe Ser Leu Glu Gly Thr
175                 180                 185

gaa act ggt gca aat gcg act tta tct att tca aat aag aca acg ctt       626
Glu Thr Gly Ala Asn Ala Thr Leu Ser Ile Ser Asn Lys Thr Thr Leu
190                 195                 200                 205

cca gac ttt aaa gca tct gtt gct acc agc agt gca tta gct aat ggt       674
Pro Asp Phe Lys Ala Ser Val Ala Thr Ser Ser Ala Leu Ala Asn Gly
                210                 215                 220
```

```
gaa gat aca att att aat act tca gga aca act caa caa ttt tct ttt     722
Glu Asp Thr Ile Ile Asn Thr Ser Gly Thr Thr Gln Gln Phe Ser Phe
            225               230               235

gaa tac aat gga aga aca ttt act ttc gat att cct tca gga aca aca     770
Glu Tyr Asn Gly Arg Thr Phe Thr Phe Asp Ile Pro Ser Gly Thr Thr
            240               245               250

gca aaa gaa ctc caa aca gct ata aat gaa aat aca aaa aat aca gga     818
Ala Lys Glu Leu Gln Thr Ala Ile Asn Glu Asn Thr Lys Asn Thr Gly
            255               260               265

gta cgt gca act ttt gaa aaa cat ggc tca gat ata gta ttg caa tta     866
Val Arg Ala Thr Phe Glu Lys His Gly Ser Asp Ile Val Leu Gln Leu
270               275               280               285

gaa gga aca gtt cct aat caa caa gtt aaa gta acc gct agc cct act     914
Glu Gly Thr Val Pro Asn Gln Gln Val Lys Val Thr Ala Ser Pro Thr
            290               295               300

gat ctt gga agt ttc aca tct tcg ggt caa gca ggc tgg aat aaa cgt     962
Asp Leu Gly Ser Phe Thr Ser Ser Gly Gln Ala Gly Trp Asn Lys Arg
            305               310               315

gat tct caa gat gct att ttt aat att aat ggt tgg gac caa gaa ctt     1010
Asp Ser Gln Asp Ala Ile Phe Asn Ile Asn Gly Trp Asp Gln Glu Leu
            320               325               330

aca tct tct aca aat gaa ctt aca gaa gtt atc cca gga ctt caa att     1058
Thr Ser Ser Thr Asn Glu Leu Thr Glu Val Ile Pro Gly Leu Gln Ile
            335               340               345

aca cta ctt tcc gaa ggg aaa aca caa att aca att cag act tct act     1106
Thr Leu Leu Ser Glu Gly Lys Thr Gln Ile Thr Ile Gln Thr Ser Thr
350               355               360               365

gac gaa gta aaa aaa caa gtt gag aaa gca gta gag tct ata aat aat     1154
Asp Glu Val Lys Lys Gln Val Glu Lys Ala Val Glu Ser Ile Asn Asn
            370               375               380

gtt ctt tcc aaa att caa gag tta act aaa gca aca gct gaa gac aaa     1202
Val Leu Ser Lys Ile Gln Glu Leu Thr Lys Ala Thr Ala Glu Asp Lys
            385               390               395

gat gat agt aaa gac act tct agt tct tca agt aaa att cca tca tat     1250
Asp Asp Ser Lys Asp Thr Ser Ser Ser Ser Ser Lys Ile Pro Ser Tyr
            400               405               410

tta caa agt cct aca aaa gtg aag gct gga cta ttt aca ggt gat act     1298
Leu Gln Ser Pro Thr Lys Val Lys Ala Gly Leu Phe Thr Gly Asp Thr
            415               420               425

ggc ata caa atg ctt agt act aga ctt aag tct atc ttt tct tct aat     1346
Gly Ile Gln Met Leu Ser Thr Arg Leu Lys Ser Ile Phe Ser Ser Asn
430               435               440               445

ggt cta ggt ttt tct cct aaa caa aca caa gat ggt cca ggg gat cta     1394
Gly Leu Gly Phe Ser Pro Lys Gln Thr Gln Asp Gly Pro Gly Asp Leu
            450               455               460

ttt tca tca ctt gct tca att ggt att gtc gta gat gct gat gag ggt     1442
Phe Ser Ser Leu Ala Ser Ile Gly Ile Val Val Asp Ala Asp Glu Gly
            465               470               475

agt gaa act ttt gga caa ctt aaa att tta gat aga gaa aca att ggt     1490
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        Ser Glu Thr Phe Gly Gln Leu Lys Ile Leu Asp Arg Glu Thr Ile Gly
            480                 485                 490

        cct gat gca cct tat aca act ctt gat gag gca tta aaa aaa gat cca      1538
        Pro Asp Ala Pro Tyr Thr Thr Leu Asp Glu Ala Leu Lys Lys Asp Pro
            495                 500                 505

        caa gca gta gca gat ata tta gct ggt agt tct gga ata tct gat tca      1586
        Gln Ala Val Ala Asp Ile Leu Ala Gly Ser Ser Gly Ile Ser Asp Ser
        510                 515                 520                 525

        aca gat ttt tct tat caa gat cat att gtt gga aaa aca caa gct ggt      1634
        Thr Asp Phe Ser Tyr Gln Asp His Ile Val Gly Lys Thr Gln Ala Gly
                            530                 535                 540

        aca tat gat gta aag tat tct gta gat gca agt ggt act ata gga gac      1682
        Thr Tyr Asp Val Lys Tyr Ser Val Asp Ala Ser Gly Thr Ile Gly Asp
                        545                 550                 555

        gtt tac att gga ggt gta aaa gct tct cta tct gat cct gca aaa aat      1730
        Val Tyr Ile Gly Gly Val Lys Ala Ser Leu Ser Asp Pro Ala Lys Asn
                    560                 565                 570

        ata tat acg gtc aca tct ggt cct gct aca ggt ctt agt ata gca gtt      1778
        Ile Tyr Thr Val Thr Ser Gly Pro Ala Thr Gly Leu Ser Ile Ala Val
            575                 580                 585

        aat aat cgt act cca ggt atc aat gta gaa agt act gta aga gtc aaa      1826
        Asn Asn Arg Thr Pro Gly Ile Asn Val Glu Ser Thr Val Arg Val Lys
        590                 595                 600                 605

        caa ggt aaa ctt agc caa ata caa gaa gca ctt aaa gct gaa gta cag      1874
        Gln Gly Lys Leu Ser Gln Ile Gln Glu Ala Leu Lys Ala Glu Val Gln
                            610                 615                 620

        caa gat cct tta aaa gaa aac aca ggt cct tta att atc atg caa gat      1922
        Gln Asp Pro Leu Lys Glu Asn Thr Gly Pro Leu Ile Ile Met Gln Asp
                        625                 630                 635

        aac tat aag gat gtt atg aaa aat ctt gag aca aga ata gaa aaa gaa      1970
        Asn Tyr Lys Asp Val Met Lys Asn Leu Glu Thr Arg Ile Glu Lys Glu
                    640                 645                 650

        aca caa aga gtt act agt tgg gaa cgt atg atg cgt tta aaa ttt tct      2018
        Thr Gln Arg Val Thr Ser Trp Glu Arg Met Met Arg Leu Lys Phe Ser
            655                 660                 665

        aga ctt gat gct gta tta gca aaa tat aat cag atg atg tca gca aat      2066
        Arg Leu Asp Ala Val Leu Ala Lys Tyr Asn Gln Met Met Ser Ala Asn
        670                 675                 680                 685

        gct tct agt tta ggg caa ctt ggt gca taa                             2096
        Ala Ser Ser Leu Gly Gln Leu Gly Ala
                            690
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<210> 10
<211> 694
<212> PRT
<213> Lawsonia intracellularis

<400> 10

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        Met Ala Asp Tyr Leu Ser Gly Gly Ile Ser Phe Gly Gly Ile Gly Ser
        1               5                   10                  15
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Gly Thr Asp Phe Gln Ala Met Ile Asp Gln Leu Lys Lys Ile Glu Leu
            20   25   30

Ile Pro Lys Asn Arg Leu Val Val Ser His Glu Gln Trp Thr Lys Lys
            35   40   45

Tyr Lys Ala Phe Glu Glu Leu Ile Lys Thr Val Lys Asp Thr Glu Ala
        50   55   60

Ser Leu Ser Lys Leu Ser Ser Val Gly Ala Ile Leu Lys Lys Glu Gly
65   70   75   80

Ser Val Ser Asn Thr Ser Val Ala Ser Val Lys Ala Ser Ser Asp Ala
                85   90   95

Ser Asp Gly Thr His Thr Ile Asp Val Lys Gln Leu Ala Thr Asn Thr
            100   105   110

Ile Leu Ser Asn Asn His Ile Phe Asp Ser Lys Thr Glu Ser Ile Asn
            115   120   125

Asn Thr Gly Ser Pro Gly Ile Phe Ala Tyr Glu Tyr Lys Gly Glu Leu
    130   135   140

His Glu Val Glu Val Pro Pro Gly Ser Asp Leu Glu Tyr Leu Ala Thr
145   150   155   160

Leu Ile Asn Lys Asp Ser Asn Asn Pro Gly Val Lys Ala Asn Leu Ile
            165   170   175

Lys Thr Gly Asp Gly Tyr Met Phe Ser Leu Glu Gly Thr Glu Thr Gly
            180   185   190

Ala Asn Ala Thr Leu Ser Ile Ser Asn Lys Thr Thr Leu Pro Asp Phe
    195   200   205

Lys Ala Ser Val Ala Thr Ser Ser Ala Leu Ala Asn Gly Glu Asp Thr
    210   215   220

Ile Ile Asn Thr Ser Gly Thr Thr Gln Gln Phe Ser Phe Glu Tyr Asn
225   230   235   240

Gly Arg Thr Phe Thr Phe Asp Ile Pro Ser Gly Thr Thr Ala Lys Glu
            245   250   255

Leu Gln Thr Ala Ile Asn Glu Asn Thr Lys Asn Thr Gly Val Arg Ala
            260   265   270

Thr Phe Glu Lys His Gly Ser Asp Ile Val Leu Gln Leu Glu Gly Thr
        275   280   285

Val Pro Asn Gln Gln Val Lys Val Thr Ala Ser Pro Thr Asp Leu Gly
        290   295   300

Ser Phe Thr Ser Ser Gly Gln Ala Gly Trp Asn Lys Arg Asp Ser Gln
305   310   315   320

Asp Ala Ile Phe Asn Ile Asn Gly Trp Asp Gln Glu Leu Thr Ser Ser
                325   330   335

Thr Asn Glu Leu Thr Glu Val Ile Pro Gly Leu Gln Ile Thr Leu Leu
        340   345   350

Ser Glu Gly Lys Thr Gln Ile Thr Ile Gln Thr Ser Thr Asp Glu Val
        355   360   365

Lys Lys Gln Val Glu Lys Ala Val Glu Ser Ile Asn Asn Val Leu Ser
        370   375   380

Lys Ile Gln Glu Leu Thr Lys Ala Thr Ala Glu Asp Lys Asp Asp Ser
385   390   395   400

Lys Asp Thr Ser Ser Ser Ser Ser Lys Ile Pro Ser Tyr Leu Gln Ser
                405   410   415

Pro Thr Lys Val Lys Ala Gly Leu Phe Thr Gly Asp Thr Gly Ile Gln
        420   425   430

Met Leu Ser Thr Arg Leu Lys Ser Ile Phe Ser Ser Asn Gly Leu Gly
        435   440   445

Phe Ser Pro Lys Gln Thr Gln Asp Gly Pro Gly Asp Leu Phe Ser Ser
        450   455   460

Leu Ala Ser Ile Gly Ile Val Val Asp Ala Asp Glu Gly Ser Glu Thr
465   470   475   480

Phe Gly Gln Leu Lys Ile Leu Asp Arg Glu Thr Ile Gly Pro Asp Ala
                485   490   495

Pro Tyr Thr Thr Leu Asp Glu Ala Leu Lys Lys Asp Pro Gln Ala Val
        500   505   510

Ala Asp Ile Leu Ala Gly Ser Ser Gly Ile Ser Asp Ser Thr Asp Phe
        515   520   525

```
Ser Tyr Gln Asp His Ile Val Gly Lys Thr Gln Ala Gly  Thr Tyr Asp
    530             535             540
```

```
Val Lys Tyr Ser Val Asp Ala Ser Gly Thr Ile Gly Asp Val Tyr Ile
545             550             555             560
```

```
Gly Gly Val Lys Ala Ser Leu Ser Asp Pro Ala Lys Asn Ile Tyr Thr
            565             570             575
```

```
Val Thr Ser Gly Pro Ala Thr Gly Leu Ser Ile Ala Val Asn Asn Arg
            580             585             590
```

```
Thr Pro Gly Ile Asn Val Glu Ser Thr Val Arg Val Lys Gln Gly Lys
        595             600             605
```

```
Leu Ser Gln Ile Gln Glu Ala Leu Lys Ala Glu Val Gln Gln Asp Pro
    610             615             620
```

```
Leu Lys Glu Asn Thr Gly Pro Leu Ile Ile Met Gln Asp Asn Tyr Lys
625             630             635             640
```

```
Asp Val Met Lys Asn Leu Glu Thr Arg Ile Glu Lys Glu Thr Gln Arg
            645             650             655
```

```
Val Thr Ser Trp Glu Arg Met Met Arg Leu Lys Phe Ser Arg Leu Asp
            660             665             670
```

```
Ala Val Leu Ala Lys Tyr Asn Gln Met Met Ser Ala Asn Ala Ser Ser
        675             680             685
```

```
Leu Gly Gln Leu Gly Ala
        690
```

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<210>  11
<211>  1200
<212>  DNA
<213>  Lawsonia intracellularis
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<220>
<221>  CDS
<222>  (13)..(1200)
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<400>  11
taggagatag tt atg gct aat gtt agt gga atc cct gca cca  cga tta ctt      51
           Met Ala Asn Val Ser Gly Ile Pro Ala Pro  Arg Leu Leu
           1               5               10
```

```
tcc aca aca aat caa atg acc aat gca gct gct ggt aat act aat aga      99
Ser Thr Thr Asn Gln Met Thr Asn Ala Ala Ala Gly Asn Thr Asn Arg
    15              20              25
```

```
gct acc ggt agt atg aac ggt cgt aat ctc aca caa ata aaa aca cct     147
Ala Thr Gly Ser Met Asn Gly Arg Asn Leu Thr Gln Ile Lys Thr Pro
```

```
          30                    35                    40                    45

cag tcc atg att gat aat gct tca gaa gaa tta aca act tct ctt gaa        195
Gln Ser Met Ile Asp Asn Ala Ser Glu Glu Leu Thr Thr Ser Leu Glu
            50                    55                        60

tct aaa agc agt gac gac ttt gca att aaa gat cgt aaa aga caa ggg        243
Ser Lys Ser Ser Asp Asp Phe Ala Ile Lys Asp Arg Lys Arg Gln Gly
            65                    70                    75

aaa gga tct gat tct cta tta aaa atg gtt caa gaa tat aca gag ctg        291
Lys Gly Ser Asp Ser Leu Leu Lys Met Val Gln Glu Tyr Thr Glu Leu
            80                    85                    90

acg aat gat gat acc cgt aat gct aaa aga gct atg tta tcc cag gta        339
Thr Asn Asp Asp Thr Arg Asn Ala Lys Arg Ala Met Leu Ser Gln Val
            95                   100                   105

tta cgt gca agt caa agt tca caa gat gta ctc gaa aaa aca tta gaa        387
Leu Arg Ala Ser Gln Ser Ser Gln Asp Val Leu Glu Lys Thr Leu Glu
110                       115                   120                   125

caa ttt tct aat aaa aca gat gct tgg gct tct ctt gca gaa att gca        435
Gln Phe Ser Asn Lys Thr Asp Ala Trp Ala Ser Leu Ala Glu Ile Ala
                    130                   135                   140

caa gaa tat ggt gca gaa tct cca cag cca aca gga tta aaa tct gta        483
Gln Glu Tyr Gly Ala Glu Ser Pro Gln Pro Thr Gly Leu Lys Ser Val
                145                   150                   155

tta gat gct atg gag aca tta gaa aat gag ttt ggt gat gaa att aaa        531
Leu Asp Ala Met Glu Thr Leu Glu Asn Glu Phe Gly Asp Glu Ile Lys
            160                   165                   170

gca gga cta aaa gga gct cta aat tca aaa gaa ttt act gat ata ggc        579
Ala Gly Leu Lys Gly Ala Leu Asn Ser Lys Glu Phe Thr Asp Ile Gly
        175                   180                   185

agt gca gca cag tta aga gat ctt tat aca aca aca gta act ata aca        627
Ser Ala Ala Gln Leu Arg Asp Leu Tyr Thr Thr Thr Val Thr Ile Thr
190                   195                   200                   205

gct gca cct gat gca gtg tta gca aga ctt ctt gaa gaa tat gag agt        675
Ala Ala Pro Asp Ala Val Leu Ala Arg Leu Leu Glu Glu Tyr Glu Ser
                    210                   215                   220

gat gat gat ctg gat aga gcc att gat ttc ctt cta tct aca ctt ggt        723
Asp Asp Asp Leu Asp Arg Ala Ile Asp Phe Leu Leu Ser Thr Leu Gly
                225                   230                   235

gga gag ctt gaa tca gct gat cca agt atg gat aaa gta cat ctt caa        771
Gly Glu Leu Glu Ser Ala Asp Pro Ser Met Asp Lys Val His Leu Gln
            240                   245                   250

agt gta atg ggt gat att gaa aaa aca caa caa ctt cat agc tct cat        819
Ser Val Met Gly Asp Ile Glu Lys Thr Gln Gln Leu His Ser Ser His
            255                   260                   265

aaa caa tgt act aca gcc ctt agc agg tgg aaa gag aaa cat aaa ggt        867
Lys Gln Cys Thr Thr Ala Leu Ser Arg Trp Lys Glu Lys His Lys Gly
270                   275                   280                   285

ggg ggg gaa aat agt aca cta act cct tta gaa atg atg cgt gaa cta        915
Gly Gly Glu Asn Ser Thr Leu Thr Pro Leu Glu Met Met Arg Glu Leu
                290                   295                   300
```

```
att gca cta aaa aat gaa aat ttt att tct cct tcc tct ata gat aaa        963
Ile Ala Leu Lys Asn Glu Asn Phe Ile Ser Pro Ser Ser Ile Asp Lys
            305             310             315

att gtt gat caa gct gat ccc caa gat att gaa aaa gaa gtc ctt ttt       1011
Ile Val Asp Gln Ala Asp Pro Gln Asp Ile Glu Lys Glu Val Leu Phe
            320             325             330

tta caa gag atg tta gct gct gta aga aaa ttt ccc att atg gta ttt       1059
Leu Gln Glu Met Leu Ala Ala Val Arg Lys Phe Pro Ile Met Val Phe
            335             340             345

gat aat gtc gaa aat cgt gta aga gtt atg ggt gct gta caa gat gct       1107
Asp Asn Val Glu Asn Arg Val Arg Val Met Gly Ala Val Gln Asp Ala
350             355             360             365

gtt gac gat gct gta aga aga gaa gat gaa ttc ctc ttt caa aaa gaa       1155
Val Asp Asp Ala Val Arg Arg Glu Asp Glu Phe Leu Phe Gln Lys Glu
            370             375             380

cat cct gat gta cca cta caa cca gat gaa aat aat ata caa taa          1200
His Pro Asp Val Pro Leu Gln Pro Asp Glu Asn Asn Ile Gln
            385             390             395
```

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<210>  12
<211>  395
<212>  PRT
<213>  Lawsonia intracelluláris

<400>  12

Met Ala Asn Val Ser Gly Ile Pro Ala Pro Arg Leu Leu Ser Thr Thr
1               5               10              15

Asn Gln Met Thr Asn Ala Ala Ala Gly Asn Thr Asn Arg Ala Thr Gly
            20              25              30

Ser Met Asn Gly Arg Asn Leu Thr Gln Ile Lys Thr Pro Gln Ser Met
            35              40              45

Ile Asp Asn Ala Ser Glu Glu Leu Thr Thr Ser Leu Glu Ser Lys Ser
            50              55              60

Ser Asp Asp Phe Ala Ile Lys Asp Arg Lys Arg Gln Gly Lys Gly Ser
65              70              75              80

Asp Ser Leu Leu Lys Met Val Gln Glu Tyr Thr Glu Leu Thr Asn Asp
                85              90              95

Asp Thr Arg Asn Ala Lys Arg Ala Met Leu Ser Gln Val Leu Arg Ala
            100             105             110

Ser Gln Ser Ser Gln Asp Val Leu Glu Lys Thr Leu Glu Gln Phe Ser
            115             120             125
```

Asn Lys Thr Asp Ala Trp Ala Ser Leu Ala Glu Ile Ala Gln Glu Tyr
   130   135   140

Gly Ala Glu Ser Pro Gln Pro Thr Gly Leu Lys Ser Val Leu Asp Ala
   145   150   155   160

Met Glu Thr Leu Glu Asn Glu Phe Gly Asp Glu Ile Lys Ala Gly Leu
                165   170   175

Lys Gly Ala Leu Asn Ser Lys Glu Phe Thr Asp Ile Gly Ser Ala Ala
                180   185   190

Gln Leu Arg Asp Leu Tyr Thr Thr Thr Val Thr Ile Thr Ala Ala Pro
        195   200   205

Asp Ala Val Leu Ala Arg Leu Leu Glu Glu Tyr Glu Ser Asp Asp Asp
   210   215   220

Leu Asp Arg Ala Ile Asp Phe Leu Leu Ser Thr Leu Gly Gly Glu Leu
  225   230   235   240

Glu Ser Ala Asp Pro Ser Met Asp Lys Val His Leu Gln Ser Val Met
              245   250   255

Gly Asp Ile Glu Lys Thr Gln Gln Leu His Ser Ser His Lys Gln Cys
             260   265   270

Thr Thr Ala Leu Ser Arg Trp Lys Glu Lys His Lys Gly Gly Gly Glu
  275   280   285

Asn Ser Thr Leu Thr Pro Leu Glu Met Met Arg Glu Leu Ile Ala Leu
  290   295   300

Lys Asn Glu Asn Phe Ile Ser Pro Ser Ser Ile Asp Lys Ile Val Asp
  305   310   315   320

Gln Ala Asp Pro Gln Asp Ile Glu Lys Glu Val Leu Phe Leu Gln Glu
             325   330   335

Met Leu Ala Ala Val Arg Lys Phe Pro Ile Met Val Phe Asp Asn Val
        340   345   350

Glu Asn Arg Val Arg Val Met Gly Ala Val Gln Asp Ala Val Asp Asp
        355   360   365

Ala Val Arg Arg Glu Asp Glu Phe Leu Phe Gln Lys Glu His Pro Asp
  370   375   380

Val Pro Leu Gln Pro Asp Glu Asn Asn Ile Gln

385   390   395

<210> 13
<211> 1269
<212> DNA
<213> Lawsonia intracellularis

<220>
<221> CDS
<222> (32)..(1222)

<400> 13
tgttggaaat tctctctgga ggagtaaagc a atg aca aat ttt gga gat ata   52
                                   Met Thr Asn Phe Gly Asp Ile
                                   1   5

agc gga agc tcc gca aga atg agt agc ttg atg act ggt aca tcc ggt   100
Ser Gly Ser Ser Ala Arg Met Ser Ser Leu Met Thr Gly Thr Ser Gly
         10   15   20

gaa gaa gga ctt gaa gaa ctt gaa ggt ggt gtt cct aaa gag caa ggt   148
Glu Glu Gly Leu Glu Glu Leu Glu Gly Gly Val Pro Lys Glu Gln Gly
     25   30   35

ggt cca ggt aaa gga gat gct tca gag gct gct aaa ggt caa gca gca   196
Gly Pro Gly Lys Gly Asp Ala Ser Glu Ala Ala Lys Gly Gln Ala Ala
40   45   50   55

gca gat agt att aat tca gct ggt ggt act gaa aag cct gga gaa gtt   244
Ala Asp Ser Ile Asn Ser Ala Gly Gly Thr Glu Lys Pro Gly Glu Val
                60   65   70

ggt gat aag gaa gat gta ggg gaa ggt ggc gaa ata cct gaa ggt ggt   292
Gly Asp Lys Glu Asp Val Gly Glu Gly Gly Glu Ile Pro Glu Gly Gly
            75   80   85

gaa ata cct gag ggt ggt gaa gaa gtt cca gag gaa ccc cca tat gtc   340
Glu Ile Pro Glu Gly Gly Glu Glu Val Pro Glu Glu Pro Pro Tyr Val
            90   95   100

cct cct cca ttg gtt gaa cca gct aaa atc agt aca gta aca gat ctc   388
Pro Pro Pro Leu Val Glu Pro Ala Lys Ile Ser Thr Val Thr Asp Leu
        105   110   115

agt acg tta atg gga tca cta cag ctg aca gag caa aaa aag aat gct   436
Ser Thr Leu Met Gly Ser Leu Gln Leu Thr Glu Gln Lys Lys Asn Ala
120   125   130   135

gaa aaa aca gta aat gaa att aaa gca cag aat aaa gag caa caa gta   484
Glu Lys Thr Val Asn Glu Ile Lys Ala Gln Asn Lys Glu Gln Gln Val
                140   145   150

aag ttc caa gag caa att aaa aag att gag gat aat att gct gaa tct   532
Lys Phe Gln Glu Gln Ile Lys Lys Ile Glu Asp Asn Ile Ala Glu Ser
                155   160   165

aag aaa agt ggt ata ctt aag ttt ttc caa aag ttg ttt gca gtt att   580
Lys Lys Ser Gly Ile Leu Lys Phe Phe Gln Lys Leu Phe Ala Val Ile
            170   175   180

ggt gct gta cta gga gct att gga ggt gcg cta gct att gct gca ggt   628
Gly Ala Val Leu Gly Ala Ile Gly Gly Ala Leu Ala Ile Ala Ala Gly
        185   190   195

```
gct gct tca ggt aac cca tta ttg gtt gct gca ggt att atg gct att      676
Ala Ala Ser Gly Asn Pro Leu Leu Val Ala Ala Gly Ile Met Ala Ile
200             205             210             215

gta gct tca att gat gca gca atg tcg tcg cta tcg gat ggt aaa gtg      724
Val Ala Ser Ile Asp Ala Ala Met Ser Ser Leu Ser Asp Gly Lys Val
                220             225             230

tcc atc tca gca ggg att agt aag gct ctt gag gct atg gga gta cca      772
Ser Ile Ser Ala Gly Ile Ser Lys Ala Leu Glu Ala Met Gly Val Pro
            235             240             245

gca gaa aca gca caa tgg att gca ttt ggt ata cag tta gca atg att      820
Ala Glu Thr Ala Gln Trp Ile Ala Phe Gly Ile Gln Leu Ala Met Ile
        250             255             260

gca gtg act ata gct att ggt ttt gcc tct ggt ggt ggt gga gca atg      868
Ala Val Thr Ile Ala Ile Gly Phe Ala Ser Gly Gly Gly Gly Ala Met
    265             270             275

gct gga gtg tca aaa ata gca gat atg ttt tca aag tct caa gat gta      916
Ala Gly Val Ser Lys Ile Ala Asp Met Phe Ser Lys Ser Gln Asp Val
280             285             290             295

gct aag ttg gca cag atg att gaa aaa gct tct aaa ata gta caa atc      964
Ala Lys Leu Ala Gln Met Ile Glu Lys Ala Ser Lys Ile Val Gln Ile
            300             305             310

gct ggt tca gtt aat cag tct gct ata ggc ggt aca ggt att ggt aca     1012
Ala Gly Ser Val Asn Gln Ser Ala Ile Gly Gly Thr Gly Ile Gly Thr
            315             320             325

gct gta gtg caa agc aat ata aaa gct aat gaa tct gaa caa aaa gaa     1060
Ala Val Val Gln Ser Asn Ile Lys Ala Asn Glu Ser Glu Gln Lys Glu
        330             335             340

att gaa gct gct att gca aaa gtt aaa gct aag ata gag acg tta caa     1108
Ile Glu Ala Ala Ile Ala Lys Val Lys Ala Lys Ile Glu Thr Leu Gln
        345             350             355

gac ttc ttt aaa aac caa atg gaa caa ttc aat gct ata atg aaa ata     1156
Asp Phe Phe Lys Asn Gln Met Glu Gln Phe Asn Ala Ile Met Lys Ile
360             365             370             375

ata aca gat att att caa gat agc gtc aat aca aaa ata gct gtt caa     1204
Ile Thr Asp Ile Ile Gln Asp Ser Val Asn Thr Lys Ile Ala Val Gln
            380             385             390

cgt ggt gca cgt gag taa tacctttagt aaatacagtg actatactat           1252
Arg Gly Ala Arg Glu
            395

aatatataaa ttaataa                                                   1269
```

<210> 14
<211> 396
<212> PRT
<213> Lawsonia intracellularis

<400> 14

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Met Thr Asn Phe Gly Asp Ile Ser Gly Ser Ser Ala Arg Met Ser Ser
1               5               10              15
```

Leu Met Thr Gly Thr Ser Gly Glu Glu Gly Leu Glu Glu Leu Glu Gly
            20   25   30

Gly Val Pro Lys Glu Gln Gly Gly Pro Gly Lys Gly Asp Ala Ser Glu
            35   40   45

Ala Ala Lys Gly Gln Ala Ala Ala Asp Ser Ile Asn Ser Ala Gly Gly
            50   55   60

Thr Glu Lys Pro Gly Glu Val Gly Asp Lys Glu Asp Val Gly Glu Gly
65   70   75   80

Gly Glu Ile Pro Glu Gly Gly Glu Ile Pro Glu Gly Gly Glu Glu Val
                  85   90   95

Pro Glu Glu Pro Pro Tyr Val Pro Pro Pro Leu Val Glu Pro Ala Lys
            100   105   110

Ile Ser Thr Val Thr Asp Leu Ser Thr Leu Met Gly Ser Leu Gln Leu
            115   120   125

Thr Glu Gln Lys Lys Asn Ala Glu Lys Thr Val Asn Glu Ile Lys Ala
      130   135   140

Gln Asn Lys Glu Gln Gln Val Lys Phe Gln Glu Gln Ile Lys Lys Ile
145   150   155   160

Glu Asp Asn Ile Ala Glu Ser Lys Lys Ser Gly Ile Leu Lys Phe Phe
                  165   170   175

Gln Lys Leu Phe Ala Val Ile Gly Ala Val Leu Gly Ala Ile Gly Gly
            180   185   190

Ala Leu Ala Ile Ala Ala Gly Ala Ala Ser Gly Asn Pro Leu Leu Val
            195   200   205

Ala Ala Gly Ile Met Ala Ile Val Ala Ser Ile Asp Ala Ala Met Ser
            210   215   220

Ser Leu Ser Asp Gly Lys Val Ser Ile Ser Ala Gly Ile Ser Lys Ala
225   230   235   240

Leu Glu Ala Met Gly Val Pro Ala Glu Thr Ala Gln Trp Ile Ala Phe
                  245   250   255

Gly Ile Gln Leu Ala Met Ile Ala Val Thr Ile Ala Ile Gly Phe Ala
            260   265   270

```
Ser Gly Gly Gly Gly Ala Met Ala Gly Val Ser Lys Ile Ala Asp Met
        275             280             285


Phe Ser Lys Ser Gln Asp Val Ala Lys Leu Ala Gln Met Ile Glu Lys
    290             295             300


Ala Ser Lys Ile Val Gln Ile Ala Gly Ser Val Asn Gln Ser Ala Ile
305             310             315             320


Gly Gly Thr Gly Ile Gly Thr Ala Val Val Gln Ser Asn Ile Lys Ala
            325             330             335


Asn Glu Ser Glu Gln Lys Glu Ile Glu Ala Ala Ile Ala Lys Val Lys
            340             345             350


Ala Lys Ile Glu Thr Leu Gln Asp Phe Phe Lys Asn Gln Met Glu Gln
        355             360             365


Phe Asn Ala Ile Met Lys Ile Ile Thr Asp Ile Ile Gln Asp Ser Val
    370             375             380


Asn Thr Lys Ile Ala Val Gln Arg Gly Ala Arg Glu
385             390             395
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<210>  15
<211>  894
<212>  DNA
<213>  Lawsonia intracellularis


<220>
<221>  CDS
<222>  (13)..(894)


<400>  15
aggaggaatt at atg tct ctt gtc att aat aac aac ctg atg gcc gtc aat        51
              Met Ser Leu Val Ile Asn Asn Asn Leu Met Ala Val Asn
                1           5                   10


gct caa cgt aac tta agc aag tct tat gga gaa ctg agt tct tct gtt        99
Ala Gln Arg Asn Leu Ser Lys Ser Tyr Gly Glu Leu Ser Ser Ser Val
    15              20              25


cga aaa ctt tct tca ggt ctt cgt gta gga act gct gct gat gac tca       147
Arg Lys Leu Ser Ser Gly Leu Arg Val Gly Thr Ala Ala Asp Asp Ser
30              35              40              45


gca ggg tta gcc att cga gaa ctc atg aga tct gac att gca aca aca       195
Ala Gly Leu Ala Ile Arg Glu Leu Met Arg Ser Asp Ile Ala Thr Thr
                50              55              60


caa caa gga ata cga aat gcg aat gat gct att tct atg att caa act       243
Gln Gln Gly Ile Arg Asn Ala Asn Asp Ala Ile Ser Met Ile Gln Thr
            65              70              75


gcg gat ggt gca ctt gga gtc atc gat gaa aag ctc att cga atg aaa       291
```

```
        Ala Asp Gly Ala Leu Gly Val Ile Asp Glu Lys Leu Ile Arg Met Lys
            80                      85                  90

        gaa ctt gct gaa caa gct gct aca ggt aca tat aac tcc act cag cgt          339
        Glu Leu Ala Glu Gln Ala Ala Thr Gly Thr Tyr Asn Ser Thr Gln Arg
            95,                     100                 105

        atg att att gac tct gaa tat caa gct atg gcc tca gaa att act cgt          387
        Met Ile Ile Asp Ser Glu Tyr Gln Ala Met Ala Ser Glu Ile Thr Arg
        110                     115                 120             125

        att gct aat gcg aca gaa ttt aat ggt ata aaa ctt ctt gat ggt tca          435
        Ile Ala Asn Ala Thr Glu Phe Asn Gly Ile Lys Leu Leu Asp Gly Ser
                        130                 135             140

        tta tca ggt aat cat gat ggg aaa aaa ata aat tca act ggt gca gta          483
        Leu Ser Gly Asn His Asp Gly Lys Lys Ile Asn Ser Thr Gly Ala Val
                    145                 150                 155

        cgt atc cac ttt ggg aca tct aac agc tct gct gaa gat tac tat gat          531
        Arg Ile His Phe Gly Thr Ser Asn Ser Ser Ala Glu Asp Tyr Tyr Asp
                    160                 165                 170

        att aaa att ggt ggc tct aca gct tct gca tta gga ctt ggt aat aca          579
        Ile Lys Ile Gly Gly Ser Thr Ala Ser Ala Leu Gly Leu Gly Asn Thr
        175                     180                 185

        gta aaa ggt gcg ggt gct aca gtc tct act caa gct gca gca caa aat          627
        Val Lys Gly Ala Gly Ala Thr Val Ser Thr Gln Ala Ala Ala Gln Asn
        190                     195                 200             205

        gcc tta aaa gct ata gat aat gcc att gtt tca aaa gat aaa att cga          675
        Ala Leu Lys Ala Ile Asp Asn Ala Ile Val Ser Lys Asp Lys Ile Arg
                        210                 215             220

        gca cac ctt ggt gga tta caa aat aga ctt gaa gct aca gtt gat aat          723
        Ala His Leu Gly Gly Leu Gln Asn Arg Leu Glu Ala Thr Val Asp Asn
                    225                 230                 235

        tta agt ata caa aat gaa aac tta caa gct gct gaa tct cgt ata tct          771
        Leu Ser Ile Gln Asn Glu Asn Leu Gln Ala Ala Glu Ser Arg Ile Ser
                    240                 245                 250

        gat ata gat gta agc caa gaa atg aca caa ttt gta cgt aac caa ata          819
        Asp Ile Asp Val Ser Gln Glu Met Thr Gln Phe Val Arg Asn Gln Ile
            255                     260                 265

        ctt aca caa aca ggt gtt gct atg ctt tca caa gct aat tct cta cca          867
        Leu Thr Gln Thr Gly Val Ala Met Leu Ser Gln Ala Asn Ser Leu Pro
        270                     275                 280             285

        cgt atg gct cag caa ctt att ggc taa                                     894
        Arg Met Ala Gln Gln Leu Ile Gly
                    290
```

<210> 16
<211> 293
<212> PRT
<213> Lawsonia intracellularis

<400> 16

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Met Ser Leu Val Ile Asn Asn Asn Leu Met Ala Val Asn Ala Gln Arg
1             5                   10                  15
```

```
Asn Leu Ser Lys Ser Tyr Gly Glu Leu Ser Ser Ser Val Arg Lys Leu
         20              25                  30


Ser Ser Gly Leu Arg Val Gly Thr Ala Ala Asp Asp Ser Ala Gly Leu
         35              40                  45


Ala Ile Arg Glu Leu Met Arg Ser Asp Ile Ala Thr Thr Gln Gln Gly
    50              55                  60


Ile Arg Asn Ala Asn Asp Ala Ile Ser Met Ile Gln Thr Ala Asp Gly
65              70              75                  80


Ala Leu Gly Val Ile Asp Glu Lys Leu Ile Arg Met Lys Glu Leu Ala
             85              90                  95


Glu Gln Ala Ala Thr Gly Thr Tyr Asn Ser Thr Gln Arg Met Ile Ile
         100             105                 110


Asp Ser Glu Tyr Gln Ala Met Ala Ser Glu Ile Thr Arg Ile Ala Asn
         115             120                 125


Ala Thr Glu Phe Asn Gly Ile Lys Leu Leu Asp Gly Ser Leu Ser Gly
    130             135                 140


Asn His Asp Gly Lys Lys Ile Asn Ser Thr Gly Ala Val Arg Ile His
145             150             155                 160


Phe Gly Thr Ser Asn Ser Ser Ala Glu Asp Tyr Tyr Asp Ile Lys Ile
             165             170                 175


Gly Gly Ser Thr Ala Ser Ala Leu Gly Leu Gly Asn Thr Val Lys Gly
         180             185                 190


Ala Gly Ala Thr Val Ser Thr Gln Ala Ala Ala Gln Asn Ala Leu Lys
         195             200                 205


Ala Ile Asp Asn Ala Ile Val Ser Lys Asp Lys Ile Arg Ala His Leu
    210             215                 220


Gly Gly Leu Gln Asn Arg Leu Glu Ala Thr Val Asp Asn Leu Ser Ile
225             230             235                 240


Gln Asn Glu Asn Leu Gln Ala Ala Glu Ser Arg Ile Ser Asp Ile Asp
             245             250                 255


Val Ser Gln Glu Met Thr Gln Phe Val Arg Asn Gln Ile Leu Thr Gln
             260             265                 270
```

```
Thr Gly Val Ala Met Leu Ser Gln Ala Asn Ser Leu Pro Arg Met Ala
        275                 280                 285


Gln Gln Leu Ile Gly
    290
```

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<210>   17
<211>   2848
<212>   DNA
<213>   Lawsonia intracellularis


<220>
<221>   CDS
<222>   (29)..(2848)


<400>   17
accttaacta aaaaataaaa agaatatt atg tat aat ata att aat aag cat          52
                                Met Tyr Asn Ile Ile Asn Lys His
                                 1               5

caa atc ata aaa att tta tta ttt tcc tta tgt gtt ttc ttt ttt aca        100
Gln Ile Ile Lys Ile Leu Leu Phe Ser Leu Cys Val Phe Phe Phe Thr
     10              15                  20

ctt aca gaa aaa caa aaa att tat gct gca gac gtc ttt ttt gag ggc        148
Leu Thr Glu Lys Gln Lys Ile Tyr Ala Ala Asp Val Phe Phe Glu Gly
 25              30                  35                  40

aga acc gaa acc tta atc aat gta aac aaa cca ttt gat tct ttt ttt        196
Arg Thr Glu Thr Leu Ile Asn Val Asn Lys Pro Phe Asp Ser Phe Phe
             45                  50                  55

gga ggt tct gac tct aca ata gga acc ctt gaa aca gga cct act aat        244
Gly Gly Ser Asp Ser Thr Ile Gly Thr Leu Glu Thr Gly Pro Thr Asn
                 60                  65                  70

ctt acc ttc aca aca gta gga gcc ttc cgc aat tct gtt ttc aga att        292
Leu Thr Phe Thr Thr Val Gly Ala Phe Arg Asn Ser Val Phe Arg Ile
             75                  80                  85

att ggt ggt ggt agg tct agt ttt aac aac cca aat aca gtt aaa ggc        340
Ile Gly Gly Gly Arg Ser Ser Phe Asn Asn Pro Asn Thr Val Lys Gly
         90                  95                  100

aat gtt act cta act gtt tat aat act gat gta gaa aga ata att ggt        388
Asn Val Thr Leu Thr Val Tyr Asn Thr Asp Val Glu Arg Ile Ile Gly
105                 110                 115                 120

gca ggt atc agc aat aga gga ctt gta acc gtt act ggc tca gta aat        436
Ala Gly Ile Ser Asn Arg Gly Leu Val Thr Val Thr Gly Ser Val Asn
                 125                 130                 135

atg aag cta gaa aat gtt tct gtt act aga gga att tat ggt ggt gtc        484
Met Lys Leu Glu Asn Val Ser Val Thr Arg Gly Ile Tyr Gly Gly Val
             140                 145                 150

tat act caa aat gga cat gta cta ggc tct atc aac atg cat ttg aaa        532
Tyr Thr Gln Asn Gly His Val Leu Gly Ser Ile Asn Met His Leu Lys
             155                 160                 165

aac gtc caa act cca cta tta ata ggt tct gga gta agc aat gga cct        580
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        Asn Val Gln Thr Pro Leu Leu Ile Gly Ser Gly Val Ser Asn Gly Pro
            170                 175                 180

        aat cgt att act gta aat gga gac ata aac att gat gtt gaa gac tct    628
        Asn Arg Ile Thr Val Asn Gly Asp Ile Asn Ile Asp Val Glu Asp Ser
        185                 190                 195                 200

        agg att caa tat gta aac att aca gga gaa gta gat gca ggg ata aaa    676
        Arg Ile Gln Tyr Val Asn Ile Thr Gly Glu Val Asp Ala Gly Ile Lys
                        205                 210                 215

        gga aat gct act cta act gta aaa aaa tct act gtt gag ctt ata aac    724
        Gly Asn Ala Thr Leu Thr Val Lys Lys Ser Thr Val Glu Leu Ile Asn
                        220                 225                 230

        tct ggt aga ggt aat atc tta ggt aat ctc aaa ata tct ata gca gat    772
        Ser Gly Arg Gly Asn Ile Leu Gly Asn Leu Lys Ile Ser Ile Ala Asp
                    235                 240                 245

        tca aat ata agg ggg tta tca cca gta gac ttt ggt tct tca gta tat    820
        Ser Asn Ile Arg Gly Leu Ser Pro Val Asp Phe Gly Ser Ser Val Tyr
                250                 255                 260

        ggg gac aca tct ata aat gta att aat tct cag att aat gat att act    868
        Gly Asp Thr Ser Ile Asn Val Ile Asn Ser Gln Ile Asn Asp Ile Thr
        265                 270                 275                 280

        ctt ata cca agg gct ggt gga atg ctt gta ggt cct gtt acc cta gat    916
        Leu Ile Pro Arg Ala Gly Gly Met Leu Val Gly Pro Val Thr Leu Asp
                        285                 290                 295

        atc aca agc agt act ata caa aat ata caa tgt ggg cct gtc agt caa    964
        Ile Thr Ser Ser Thr Ile Gln Asn Ile Gln Cys Gly Pro Val Ser Gln
                        300                 305                 310

        aat aat caa ctt aac aca cta aat gta act gtt aat act agt aac att   1012
        Asn Asn Gln Leu Asn Thr Leu Asn Val Thr Val Asn Thr Ser Asn Ile
                    315                 320                 325

        act aac tta aac ctt ggt agt gtc gaa ggt cat aca ata tca act aca   1060
        Thr Asn Leu Asn Leu Gly Ser Val Glu Gly His Thr Ile Ser Thr Thr
                330                 335                 340

        gca act gtt act gat agt aat att act aac ctt aat gtc gga acc ttc   1108
        Ala Thr Val Thr Asp Ser Asn Ile Thr Asn Leu Asn Val Gly Thr Phe
        345                 350                 355                 360

        aat gga ctt gga gta act gag aat gcc tct gta atc att aat agt ggc   1156
        Asn Gly Leu Gly Val Thr Glu Asn Ala Ser Val Ile Ile Asn Ser Gly
                        365                 370                 375

        aat att act aac ctt aat gtc gga act aat gta ata gct gca gcc aca   1204
        Asn Ile Thr Asn Leu Asn Val Gly Thr Asn Val Ile Ala Ala Ala Thr
                        380                 385                 390

        act att aat tcc tct gcg acc ata cac gac gga ctt att gca aac ctt   1252
        Thr Ile Asn Ser Ser Ala Thr Ile His Asp Gly Leu Ile Ala Asn Leu
                    395                 400                 405

        acc tta ggc tca caa ggt aat ggt cgt act atg ata gct aca gca aat   1300
        Thr Leu Gly Ser Gln Gly Asn Gly Arg Thr Met Ile Ala Thr Ala Asn
            410                 415                 420

        gtt aat ggt gga act att gga tta tta act atg ggt tca gaa aac ttc   1348
        Val Asn Gly Gly Thr Ile Gly Leu Leu Thr Met Gly Ser Glu Asn Phe
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          425                      430                      435                      440
ata cca ggc aca aga cca att act gaa tta gca ata cta aac atg tct        1396
Ile Pro Gly Thr Arg Pro Ile Thr Glu Leu Ala Ile Leu Asn Met Ser
                445                      450                      455

ggt gga tta att gaa aga att atc gta ggt aat gcc aac tct tca acc        1444
Gly Gly Leu Ile Glu Arg Ile Ile Val Gly Asn Ala Asn Ser Ser Thr
                460                      465                      470

ata aac ttt act cct ggg aag aga tca att gta aaa aca ata aat ggt        1492
Ile Asn Phe Thr Pro Gly Lys Arg Ser Ile Val Lys Thr Ile Asn Gly
                475                      480                      485

cca gaa ctt cca tat tta gtt aac ata caa aaa ggt gct atg aca caa        1540
Pro Glu Leu Pro Tyr Leu Val Asn Ile Gln Lys Gly Ala Met Thr Gln
                490                      495                      500

tgg ggc act aaa aat atg ccc ttt tta ttg gat aca aga aat tta atc        1588
Trp Gly Thr Lys Asn Met Pro Phe Leu Leu Asp Thr Arg Asn Leu Ile
505                      510                      515                      520

ttg tcc gga act ctg att acc tca aat att caa cta gct gat tta tct        1636
Leu Ser Gly Thr Leu Ile Thr Ser Asn Ile Gln Leu Ala Asp Leu Ser
                525                      530                      535

ata acc aat cta ttt gtt gct aat ggc ggt aca cta gta cct aga aaa        1684
Ile Thr Asn Leu Phe Val Ala Asn Gly Gly Thr Leu Val Pro Arg Lys
                540                      545                      550

tta ata cct ggg aac caa cct gtt ata cag ttt ctt gga ggt cct caa        1732
Leu Ile Pro Gly Asn Gln Pro Val Ile Gln Phe Leu Gly Gly Pro Gln
                555                      560                      565

tca ctc tta gtt atc cat caa cca tta aaa gta aat tta agc tta tca        1780
Ser Leu Leu Val Ile His Gln Pro Leu Lys Val Asn Leu Ser Leu Ser
                570                      575                      580

cca aaa ctt att gga agt agc atg gtg cca ctt gct ttt gtc tct caa        1828
Pro Lys Leu Ile Gly Ser Ser Met Val Pro Leu Ala Phe Val Ser Gln
585                      590                      595                      600

tct ttt tca tca cca gat ctt ttt gtt aaa caa act aga agt ggt ctc        1876
Ser Phe Ser Ser Pro Asp Leu Phe Val Lys Gln Thr Arg Ser Gly Leu
                605                      610                      615

att tgg agt gat ctt gag ttt gat cca aca aca tct att tgg tat gtt        1924
Ile Trp Ser Asp Leu Glu Phe Asp Pro Thr Thr Ser Ile Trp Tyr Val
                620                      625                      630

aat aat atc caa gca tct caa gat ttt tac tct ttc tct att gct cgt        1972
Asn Asn Ile Gln Ala Ser Gln Asp Phe Tyr Ser Phe Ser Ile Ala Arg
                635                      640                      645

gag act act aac tgg cta aga caa caa cat ata tgg act cta caa aac        2020
Glu Thr Thr Asn Trp Leu Arg Gln Gln His Ile Trp Thr Leu Gln Asn
                650                      655                      660

cgt tca agt aaa ctt tta gac aac gaa cat tat gga cta tgg ata aat        2068
Arg Ser Ser Lys Leu Leu Asp Asn Glu His Tyr Gly Leu Trp Ile Asn
665                      670                      675                      680

gtt caa ggt gga cat gaa agt ctt gat act tct att ggt agc aaa gca        2116
Val Gln Gly Gly His Glu Ser Leu Asp Thr Ser Ile Gly Ser Lys Ala
                685                      690                      695
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aaa atg cca tgg ata  atg gca aca gca gga  tat gac tat ctt caa caa      2164
Lys Met Pro Trp Ile  Met Ala Thr Ala Gly  Tyr Asp Tyr Leu Gln Gln
            700                    705                710

cta cca agg tta gat  atg aaa gcc ctt tat  ggt ctt gct ttt ggt gct      2212
Leu Pro Arg Leu Asp  Met Lys Ala Leu Tyr  Gly Leu Ala Phe Gly Ala
            715                    720                725

tct aaa ggt aaa agt  aaa tgg tct agc gtc  aac tct aca aaa aat gat      2260
Ser Lys Gly Lys Ser  Lys Trp Ser Ser Val  Asn Ser Thr Lys Asn Asp
            730                    735                740

gct gag cta ggt atg  gtt agt ggt tat gta  ggt ctt atc cat aac aaa      2308
Ala Glu Leu Gly Met  Val Ser Gly Tyr Val  Gly Leu Ile His Asn Lys
745                    750                755                760

act ggg ctc tat agt  aca ttg acc tta caa  ctt gcg tct agt aaa tta      2356
Thr Gly Leu Tyr Ser  Thr Leu Thr Leu Gln  Leu Ala Ser Ser Lys Leu
            765                    770                775

cat act aat tct aca  ggg ttc tat aga aat  ttt aaa tgg aca gaa aca      2404
His Thr Asn Ser Thr  Gly Phe Tyr Arg Asn  Phe Lys Trp Thr Glu Thr
            780                    785                790

act cca aca gaa gca  ctt gaa ctt gga tgg  aaa tac act ttc aac aac      2452
Thr Pro Thr Glu Ala  Leu Glu Leu Gly Trp  Lys Tyr Thr Phe Asn Asn
            795                    800                805

ggt att aaa atg aat  cct cgt gga caa ctt  att ttt gaa caa aca tct      2500
Gly Ile Lys Met Asn  Pro Arg Gly Gln Leu  Ile Phe Glu Gln Thr Ser
            810                    815                820

aaa cac cat ttt gat  tta gga att caa aat  gat aag gct ata tta gat      2548
Lys His His Phe Asp  Leu Gly Ile Gln Asn  Asp Lys Ala Ile Leu Asp
825                    830                835                840

aaa agc cag tta ata  aca agt tct ctt ggt  att acc gtt gaa tat aag      2596
Lys Ser Gln Leu Ile  Thr Ser Ser Leu Gly  Ile Thr Val Glu Tyr Lys
            845                    850                855

cta cca gtt acc aca  cct att aat ctt tat  gct ggt att gaa agg ata      2644
Leu Pro Val Thr Thr  Pro Ile Asn Leu Tyr  Ala Gly Ile Glu Arg Ile
            860                    865                870

aaa ggt cag tct gga  aac ttt gca att agt  tcc cag agc ctt caa atg      2692
Lys Gly Gln Ser Gly  Asn Phe Ala Ile Ser  Ser Gln Ser Leu Gln Met
            875                    880                885

aag ttc aag cat gac  aat gat aca agt gta  gtt aga gca aca ata ggt      2740
Lys Phe Lys His Asp  Asn Asp Thr Ser Val  Val Arg Ala Thr Ile Gly
            890                    895                900

aca aat ata tta ttg  gga gaa cat ttt aat  att cac tgt gat ata ttt      2788
Thr Asn Ile Leu Leu  Gly Glu His Phe Asn  Ile His Cys Asp Ile Phe
905                    910                915                920

gga gat aaa gga aat  gat aaa ggc att ggt  ggg caa gca gga ttt aca      2836
Gly Asp Lys Gly Asn  Asp Lys Gly Ile Gly  Gly Gln Ala Gly Phe Thr
            925                    930                935

tac aaa ttt taa                                                        2848
Tyr Lys Phe
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<210>  18
<211>  939
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<213>  Lawsonia intracellularis

<400>  18

Met Tyr Asn Ile Ile Asn Lys His Gln Ile Ile Lys Ile Leu Leu Phe
1               5                   10                  15

Ser Leu Cys Val Phe Phe Phe Thr Leu Thr Glu Lys Gln Lys Ile Tyr
            20                  25                  30

Ala Ala Asp Val Phe Phe Glu Gly Arg Thr Glu Thr Leu Ile Asn Val
        35                  40                  45

Asn Lys Pro Phe Asp Ser Phe Phe Gly Gly Ser Asp Ser Thr Ile Gly
    50                  55                  60

Thr Leu Glu Thr Gly Pro Thr Asn Leu Thr Phe Thr Thr Val Gly Ala
65                  70                  75                  80

Phe Arg Asn Ser Val Phe Arg Ile Ile Gly Gly Gly Arg Ser Ser Phe
                85                  90                  95

Asn Asn Pro Asn Thr Val Lys Gly Asn Val Thr Leu Thr Val Tyr Asn
            100                 105                 110

Thr Asp Val Glu Arg Ile Ile Gly Ala Gly Ile Ser Asn Arg Gly Leu
            115                 120                 125

Val Thr Val Thr Gly Ser Val Asn Met Lys Leu Glu Asn Val Ser Val
    130                 135                 140

Thr Arg Gly Ile Tyr Gly Gly Val Tyr Thr Gln Asn Gly His Val Leu
145                 150                 155                 160

Gly Ser Ile Asn Met His Leu Lys Asn Val Gln Thr Pro Leu Leu Ile
                165                 170                 175

Gly Ser Gly Val Ser Asn Gly Pro Asn Arg Ile Thr Val Asn Gly Asp
            180                 185                 190

Ile Asn Ile Asp Val Glu Asp Ser Arg Ile Gln Tyr Val Asn Ile Thr
        195                 200                 205

Gly Glu Val Asp Ala Gly Ile Lys Gly Asn Ala Thr Leu Thr Val Lys
    210                 215                 220

Lys Ser Thr Val Glu Leu Ile Asn Ser Gly Arg Gly Asn Ile Leu Gly
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        225                  230                  235                  240

Asn Leu Lys Ile Ser Ile Ala Asp Ser Asn Ile Arg Gly Leu Ser Pro
                245                  250                  255

Val Asp Phe Gly Ser Ser Val Tyr Gly Asp Thr Ser Ile Asn Val Ile
                260                  265                  270

Asn Ser Gln Ile Asn Asp Ile Thr Leu Ile Pro Arg Ala Gly Gly Met
                275                  280                  285

Leu Val Gly Pro Val Thr Leu Asp Ile Thr Ser Ser Thr Ile Gln Asn
    290                  295                  300

Ile Gln Cys Gly Pro Val Ser Gln Asn Asn Gln Leu Asn Thr Leu Asn
305                  310                  315                  320

Val Thr Val Asn Thr Ser Asn Ile Thr Asn Leu Asn Leu Gly Ser Val
                325                  330                  335

Glu Gly His Thr Ile Ser Thr Thr Ala Thr Val Thr Asp Ser Asn Ile
                340                  345                  350

Thr Asn Leu Asn Val Gly Thr Phe Asn Gly Leu Gly Val Thr Glu Asn
                355                  360                  365

Ala Ser Val Ile Ile Asn Ser Gly Asn Ile Thr Asn Leu Asn Val Gly
    370                  375                  380

Thr Asn Val Ile Ala Ala Ala Thr Thr Ile Asn Ser Ser Ala Thr Ile
385                  390                  395                  400

His Asp Gly Leu Ile Ala Asn Leu Thr Leu Gly Ser Gln Gly Asn Gly
                405                  410                  415

Arg Thr Met Ile Ala Thr Ala Asn Val Asn Gly Gly Thr Ile Gly Leu
                420                  425                  430

Leu Thr Met Gly Ser Glu Asn Phe Ile Pro Gly Thr Arg Pro Ile Thr
                435                  440                  445

Glu Leu Ala Ile Leu Asn Met Ser Gly Gly Leu Ile Glu Arg Ile Ile
    450                  455                  460

Val Gly Asn Ala Asn Ser Ser Thr Ile Asn Phe Thr Pro Gly Lys Arg
465                  470                  475                  480

Ser Ile Val Lys Thr Ile Asn Gly Pro Glu Leu Pro Tyr Leu Val Asn
                485                  490                  495
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Ile Gln Lys Gly Ala Met Thr Gln Trp Gly Thr Lys Asn Met Pro Phe
        500                 505                 510

Leu Leu Asp Thr Arg Asn Leu Ile Leu Ser Gly Thr Leu Ile Thr Ser
        515                 520                 525

Asn Ile Gln Leu Ala Asp Leu Ser Ile Thr Asn Leu Phe Val Ala Asn
        530                 535                 540

Gly Gly Thr Leu Val Pro Arg Lys Leu Ile Pro Gly Asn Gln Pro Val
545                 550                 555                 560

Ile Gln Phe Leu Gly Gly Pro Gln Ser Leu Leu Val Ile His Gln Pro
                565                 570                 575

Leu Lys Val Asn Leu Ser Leu Ser Pro Lys Leu Ile Gly Ser Ser Met
                580                 585                 590

Val Pro Leu Ala Phe Val Ser Gln Ser Phe Ser Ser Pro Asp Leu Phe
                595                 600                 605

Val Lys Gln Thr Arg Ser Gly Leu Ile Trp Ser Asp Leu Glu Phe Asp
        610                 615                 620

Pro Thr Thr Ser Ile Trp Tyr Val Asn Asn Ile Gln Ala Ser Gln Asp
625                 630                 635                 640

Phe Tyr Ser Phe Ser Ile Ala Arg Glu Thr Thr Asn Trp Leu Arg Gln
                645                 650                 655

Gln His Ile Trp Thr Leu Gln Asn Arg Ser Ser Lys Leu Leu Asp Asn
                660                 665                 670

Glu His Tyr Gly Leu Trp Ile Asn Val Gln Gly Gly His Glu Ser Leu
                675                 680                 685

Asp Thr Ser Ile Gly Ser Lys Ala Lys Met Pro Trp Ile Met Ala Thr
        690                 695                 700

Ala Gly Tyr Asp Tyr Leu Gln Gln Leu Pro Arg Leu Asp Met Lys Ala
705                 710                 715                 720

Leu Tyr Gly Leu Ala Phe Gly Ala Ser Lys Gly Lys Ser Lys Trp Ser
                725                 730                 735

Ser Val Asn Ser Thr Lys Asn Asp Ala Glu Leu Gly Met Val Ser Gly
                740                 745                 750
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Tyr Val Gly Leu Ile His Asn Lys Thr Gly Leu Tyr Ser Thr Leu Thr
        755   760   765

Leu Gln Leu Ala Ser Ser Lys Leu His Thr Asn Ser Thr Gly Phe Tyr
        770   775   780

Arg Asn Phe Lys Trp Thr Glu Thr Thr Pro Thr Glu Ala Leu Glu Leu
785   790   795   800

Gly Trp Lys Tyr Thr Phe Asn Asn Gly Ile Lys Met Asn Pro Arg Gly
                805   810   815

Gln Leu Ile Phe Glu Gln Thr Ser Lys His His Phe Asp Leu Gly Ile
            820   825   830

Gln Asn Asp Lys Ala Ile Leu Asp Lys Ser Gln Leu Ile Thr Ser Ser
        835   840   845

Leu Gly Ile Thr Val Glu Tyr Lys Leu Pro Val Thr Thr Pro Ile Asn
    850   855   860

Leu Tyr Ala Gly Ile Glu Arg Ile Lys Gly Gln Ser Gly Asn Phe Ala
865   870   875   880

Ile Ser Ser Gln Ser Leu Gln Met Lys Phe Lys His Asp Asn Asp Thr
                885   890   895

Ser Val Val Arg Ala Thr Ile Gly Thr Asn Ile Leu Leu Gly Glu His
            900   905   910

Phe Asn Ile His Cys Asp Ile Phe Gly Asp Lys Gly Asn Asp Lys Gly
        915   920   925

Ile Gly Gly Gln Ala Gly Phe Thr Tyr Lys Phe
    930   935